January-February 1994

PROGRAM MANAGER

Journal of the Defense Systems Management College

Counterpoint

Readiness

Evolution in C² Development

Gliding into History

BELIEVE IT OR NOT...
GLIDERS PRECEDED THE
CARGO-ASSAULT C-130
(SEE PAGE24)

Best
Available
Copy

PROGRAM MANAGER

Journal of the Defense Systems Management College

VOL. XXIII, No. 1, DSMC 118

Published by the

DEFENSE SYSTEMS MANAGEMENT COLLEGE PRESS

Commandant
Brig Gen (Sel.) Claude M. Bolton, Jr., USAF

Provost and Deputy Commandant
Edward Hirsch

Dean
Research, Consulting and Information Division
Dr. Adelia E. Ritchie

Associate Dean of Information and Director, DSMC Press
Wilbur D. Jones, Jr.

PROGRAM MANAGER
Managing Editor
Esther M. Farria

Art Director
Greg Caruth

Typography and Design
Paula Croisetiere

Program Manager *(ISSN 0199-7114) is published bimonthly.*

POSTMASTER: Send address changes to:
DEFENSE SYST MGMT COLG
ATTN DSMC PRESS
9820 BELVOIR ROAD
SUITE G38
FT BELVOIR VA 22060-5565.

To subscribe, government personnel should submit written requests (using their business address) to the above address.

Nongovernment employees and organizations may subscribe at $9.50 annually through the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. Second class postage paid at Fort Belvoir, VA, and at additional entry offices.

Manuscripts, Letters to the Editor, and other correspondence are welcome and should be addressed to the DSMC PRESS. Inquiries concerning proposed articles may be made by phone at (703) 805-2892/3056 or DSN 655-2892/3056.

Whenever masculine nouns or pronouns appear, other than with obvious reference to named male individuals, they have been used for literary purposes and are meant in their generic sense.

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified	**1b. RESTRICTIVE MARKINGS** None
2a. SECURITY CLASSIFICATION AUTHORITY	**3. DISTRIBUTION/AVAILABILITY OF REPORT** Distribution Unlimited
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	**5. MONITORING ORGANIZATION REPORT NUMBER(S)**
6a. NAME OF PERFORMING ORGANIZATION Defense Systems Mgmt College; **6b. OFFICE SYMBOL** *(If applicable)* DSMC Press	**7a. NAME OF MONITORING ORGANIZATION** Same as 6a
6c. ADDRESS *(City, State, and ZIP Code)* 9820 Belvoir Road, Suite G38, Fort Belvoir, VA 22060-5565	**7b. ADDRESS** *(City, State, and ZIP Code)* Same as 6c
8a. NAME OF FUNDING/SPONSORING ORGANIZATION Same as 6a; **8b. OFFICE SYMBOL** *(If applicable)*	**9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER**
8c. ADDRESS *(City, State, and ZIP Code)* Same as 6c	**10. SOURCE OF FUNDING NUMBERS** PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO.

11. TITLE *(Include Security Classification)*

Program Manager - Journal of the Defense Systems Management College VOL. XXIII, No. 1,DSMC 118

12. PERSONAL AUTHOR(S)

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
Journal	FROM ______ TO ______	January-February 1994	44

16. SUPPLEMENTARY NOTATION

17. COSATI CODES

FIELD	GROUP	SUB-GROUP

18. SUBJECT TERMS *(Continue on reverse if necessary and identify by block number)*

Software Acquisition Management; Roadmap for MILSPEC Reform; Lessons Learned/Best Practices; Department of the Navy Strategic Systems Programs Office

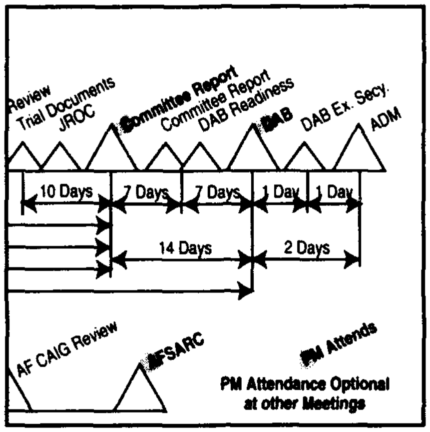
19. ABSTRACT *(Continue on reverse if necessary and identify by block number)*

Program Manager is intended to be a vehicle for the transmission of information on policies, trends, events, and current thinking affecting program management and defense systems acquisition.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT ☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	**21. ABSTRACT SECURITY CLASSIFICATION** Unclassified
22a. NAME OF RESPONSIBLE INDIVIDUAL Sylvia Nance	**22b. TELEPHONE** *(Include Area Code)* 703-805-2743; **22c. OFFICE SYMBOL** OS-PR

DD Form 1473, JUN 86 *Previous editions are obsolete.* SECURITY CLASSIFICATION OF THIS PAGE

Cover: The Cargo-Assault C-130 (photo courtesy of Lockheed).



Also

PROGRAM MANAGER MANAGING EDITOR RETIRES

Mrs. Catherine M. Clark, Managing Editor of *Program Manager* since 1978, retired on December 31, 1993, after 15 years of dedicated service to the Defense Systems Management College.

Mrs. Esther M. Farria, Associate Editor of *Program Manager* for almost 10 years, has assumed the duties of Managing Editor.

RECOGNIZE RISKS EARLY

SOFTWARE ACQUISITION MANAGEMENT

In a Nutshell

James H. Dobbins

Volumes have been written about acquisition management, and part of that mass of information discusses software management. The problem with software acquisition management information is that it is voluminous and scattered all over.

In law school, some of the most popular little books are the "nutshell" series published by West Publishing Co.: *Contract Law in a Nutshell*, etc. The objective of this article is to provide you with a nutshell capsule summary of information you need for software acquisition management. I hope you find it useful.

Why Software Management Is Difficult

Software management is difficult because of uncertainty and risk (big surprise?). It's usually very difficult to recognize software risks as they surface. You generally see software risk later, sometimes much later, when it is no longer a risk but has become a problem and costly or even impossible to correct. But, you should see it and plan for it much earlier. The software risk driven problems are *usually* management, not technical. During acquisition, we seldom consider the things that "kill" us later. We wear cost-proposal blinders. Acquisition managers need to do eight things better.

Eight Cost-Proposal Blinders

1. Use metrics properly. Understand metrics implications.
2. Understand the implications of software process capability maturity.
3. Understand when we do and don't need an independent verification and validation contractor.
4. Understand system performance implications of software quality.
5. Don't let low software cost blind us to its potential effect on the system.
6. Do software requirements a *lot* better.
7. Learn how to *build visibility* requirements *into the RFP/Contract.*
8. Learn how to establish sensible software source-selection criteria.

Twenty-three Sources of Software Risk and Uncertainty

Having done those eight things better, acquisition managers need to understand the following 23 sources of software risk and uncertainty.

1. Government and contractor lack of understanding of the effect of *software process maturity*.
2. Lack of software experience in top management. Ignorance of the law is no excuse.
3. Lack of understanding of when, how and what to measure (software metrics).
4. Lack of understanding of how best to get current information/visibility.

During acquisition, we seldom consider the things that "kill" us later. We wear cost-proposal blinders.

Mr. Dobbins is a Professor of Systems Management at the Defense Systems Management College and Course Director for the Management of Software Acquisition Course.

5. Lack of understanding of how to use measurement (metric) information.

6. Lack of understanding of full spectrum of contractor testing.

7. Lack of understanding of how to utilize the test concept in software fully.

8. Lack of understanding of the fundamental and significant differences between software and hardware concepts for common terms such as reliability and availability.

9. Failure to incorporate proper rigor and knowledge into source-selection criteria.

10. Lack of understanding of how to plan for software risks so the risks stay risks instead of becoming problems.

11. Lack of understanding that software isn't magic.

12. Lack of understanding how software fits into the system engineering process.

13. Failure to understand software architecture and the effects of changes. Why you can add a window to the top floor of the nine-story software building, but you can't add a basement.

14. Lack of understanding that software engineering is a discipline; a process.

15. Lack of understanding of the implications of insufficient time allocated for: Software Requirements, Software Design, Concurrent Engineering, In-Process Quality Analysis, Design for Reuse, PDR/CDR, Error Correction, Error, Analysis and Error Prevention.

16. Lack of understanding why highly-structured languages like Ada are good for the DOD software engineering environment where most developers are process immature.

17. Lack of understanding that good software development is event driven, not schedule driven.

18. Lack of understanding of the software acquisition life-cycle activities and their purpose.

19. Abdication of decision making to contractors because we don't want to deal with software issues.

20. Lack of trust of good contractors.

21. Too much trust in less-than-competent contractors.

22. Failure to make sure you have systems engineering capability in the program office staff.

23. Letting esoteric technology issues cloud your software decision making ability.

Twenty-nine Rules for Managing Software Acquisition

The 29 rules for managing software acquisition are as follows:

1. Learn not to be afraid of software. Put your arm around it and give it a hug.

2. Understand and manage the software development *process*.

3. Understand the greatest strength of software: flexibility.

4. Understand the greatest weakness of software: flexibility.

5. Learn and recognize the software issues that can kill you.

6. Understand that the software development process is manageable as is any engineering process.

7. Learn the importance of software configuration management.

8. Learn the different kinds of software tests, and when and how they can be used best.

9. Let the requirements definition process happen. Don't close it too soon. Keep the user involved. Understand how to do good prototyping.

10. Learn that software requirements changes after critical design review (CDR) can kill your system cost, schedule and performance. Don't let the user or contractor jerk you around after CDR. Don't jerk the contractor around after CDR.

11. Recognize that a software preliminary design review (PDR) or CDR done too early might as well not be done at all.

12. Recognize that once you are beyond the software B5 spec (software requirements spec), the user is probably useless in reviewing software documents.

13. Never underestimate what a good, process-mature, software contractor can do for you to pull you out of a cost/schedule/performance hole.

14. Never forget that a process-immature software contractor will be virtually useless in pulling you out of a cost/schedule/performance hole.

15. Never forget that if you hire a process-immature software contractor, your success or failure on the contract will happen in spite of your skill as a program manager, not because of it.

16. Never forget that software has no production cycle. The first article is "it" and if you fail, you're dead in the water.

17. Always think *risk* at every step of the software acquisition process. Remember *risk* is always a potential. When the risk event happens, it has become a problem.

18. Trying to manage performance outcome is a blueprint for disaster. Learn to manage process.

19. Always think software support (PDSS) at every step of the software acquisition process.

20. Learn that for unprecedented systems, the waterfall model of software development doesn't work. Don't let DoD-STD-2167A drive you over that waterfall in a barrel.

21. Learn that for unprecedented systems, you must prototype software as you have to prototype hardware. It takes time, but that's the way you learn what requirements are. Let this happen and move PDR/CDR if you have to.

22. Learn to get your metric information and software status from your computer resource working group (CRWG) and monthly reviews, not just in CDRLs which take too long to produce. The data are too old by the time you get it.

23. Get software expertise and systems engineering expertise in your program office, even if only on a consulting basis.

24. Understand that commercial off-the-shelf (COTS) software seldom works in custom-designed unprecedented systems, especially in embedded system software.

25. Never incorporate a Non-Development Item (NDI) or COTS software in a system without first having the contractor evaluate the feasibility *in the intended environment*. It seldom

odes

or

A-1

works as well in the intended environment as you had hoped.

26. Never force a certain technology, like object-oriented design, on a contractor unless you really need it. It can be like asking a toddler to drive an Indy 500 race car.

27. Understand that if you design for reuse, it will cost more. The payback comes later, possibly on the next program.

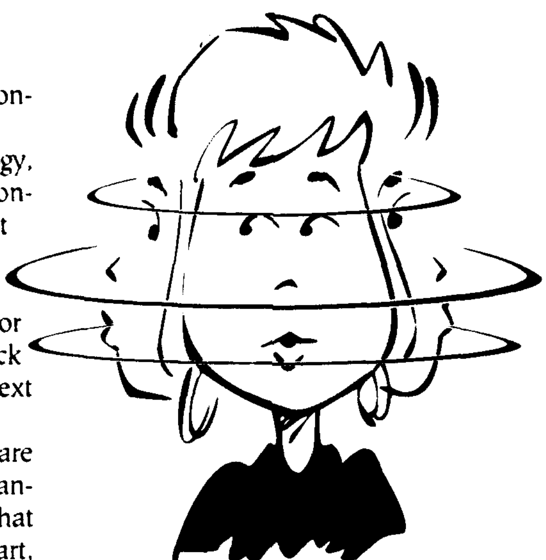
28. Learn to use, and tailor, software standards, including industry standards. Read them. Understand what they require. If you don't need a part, tailor it out.

29. Set up and use a Computer Resources Working Group. Make sure they produce and keep up-to-date your Computer Resources Life-Cycle Management Plan (CRLCMP). Watch your interfaces. Get the Interface Control Working Group (ICWG) in place early and use them. Make the CRWG interface with the ICWG and other working groups (WGs).

Recognizing Software Risks

Remember that risks are always a future consideration. Once a risk event happens, it is no longer a risk; it is a problem. How far in the future you can spot a risk is a function of how well you do measurement and strategic planning. We look at risk in terms of probability and severity. If low severity, you may not care if it occurs. If high severity, you had better care a lot. If high severity, but low probability, you should always get nervous. If the probability of a high-severity risk is not zero, you always worry about when your number is coming up. You must build fall-back positions into your strategic planning. There are questions you need to ask yourself about different types of software risk.

Feasibility Risks: Can we do the job? Is the technology there? Can this contractor do the job? How much experience does he have? Is the task unprecedented for this contractor? Do you know all the requirements? How sure are you? Are the users involved in requirements definition? Do you have to prototype? Has the contractor ever done prototyping? Should you use an acquisition strategy of evolutionary acquisition?



Remember that risks are always a future consideration. Once a risk event happens, it is no longer a risk; it is a problem.

Engineering and Producibility: Do you have to do evolutionary acquisition (requirements not fully determinable for Block 1)? Can you produce a working system for Block 1? Does the contractor have requisite skills?

Do you have to supplement the contractor with a directed subcontractor? What is the contractor's process capability maturity? Do you need to do a Software Capability Evaluation (SCE) or equivalent? Do you have a means for doing a software pre-award audit? Have you factored these possibilities into your source-selection criteria? Who can you get to do the audit? What is the contractor's meaningful experience with the language (Ada)? In what environments? Does the schedule give the contractor enough time for requirements definition?

Are you and the contractor working together to minimize post-CDR requirements changes? What kind of communications processes have you set up with the contractor to address and control technical issues? Does the schedule give the contractor enough time for design? Do you understand the contractor's software test program? Is it adequate? Do you and the contractor understand which metrics the contractor is using and the utility of the information? Does the contractor management use the information? Are meaningful metrics being used in all life-cycle phases?

How does the contractor select and use Computer-Aided Software Engineering (CASE) tools? Which ones? Why were they chosen? Are they force multipliers? Is the contractor dependent on a subcontractor? How well do they manage subcontractors? How do you know? What evidence? Do you understand the contractor's software quality process? Do you understand the contractor's software configuration management process?

Cost Risks: Do you expect the contractor's cost proposal to be accurate? Why? What will you do if it isn't? What if, by the time you hit CDR, you are seeing a 40-60 percent overrun? What are your fall-back options? Plan for these well in advance, because this is likely to be what happens. Cost estimates on unprecedented systems are usually a lot lower than eventual reality. We simply don't know how to do it better.

One thing that helps is a well-written Statement of Work (SOW). Do your strategic planning early. Plan for cost overruns and alternate actions you must take. Make sure you collect the necessary metrics often to spot potential cost overruns as far in advance as possible. Always know the difference between requirements and desirements. Never cut requirements; just desirements.

Rules to Follow

Follow the next 17 rules to keep software contracting from "biting" you:

1. Invoke the desired standards (DoD-STD-2167A, DoD-STD-2168, MILSTD-1521B and DoD-STD-973, or industry standards like IEEE-STD-982.1). Invoke these standards in Section 3 of the SOW, and anywhere else you need them, not just Section 2. Tailor them where necessary; never invoke "blanket" standards. Always know what you are imposing, and what you are tailoring. Read the standards.

2. Watch for pitfalls in chaining standards between specification documents. Treat each specification as a stand-alone in terms of standards invocation.

3. If you want metrics, ask for them. If you want specific metrics used, say so in the RFP/Contract.

4. If you want metric data provided, say when and how and how often.

5. Ask the contractor to describe their own:
- —Software engineering environment, including CASE tools
- —Software management, including subcontractor management process
- —Software development processes and tools
- —Error correction/analysis process
- —Software test and evaluation process; all of it, at each life cycle phase.

6. If you want to see *CASE* tool output, say so. What, when, how and how often.

7. If you want specific processes used, say so.

8. If you want *software root cause analyses* instead of bug fixes, say so. Allow time for it. Why would you want this? Because the industry average is that 14.7 percent of software error (bugs) fixes are bad fixes, and fast-bug fixing can turn your software into spaghetti code overnight, and you won't have enough money left to recover. Remember software's biggest weakness — flexibility.

9. When you know what you want, make it part of the source-selection criteria. Use the criteria to drive you to the most capable, not just the cheapest, contractor.

A lowest-price software contractor may be your most-expensive choice. It may be your best choice. *It Depends.* It depends on their software engineering and quality processes, metrics, use of *CASE* tools, and their process capability maturity. If they are process capability *immature*, don't know how to use *CASE* tools, and are low bidder, run, don't walk, to the next contractor in line. You'll be sorry if you don't. When you get the proposals, read them critically. Read between the hype, between the chest-pounding, and get to the real meat. The rest they must include because we expect it. But, listen to what they say they really do. Then do a pre-award audit or software capability evaluation.

10. In proposal responses:
- —Read the Software Development Plan (SDP)
- —Read the Quality Plan
- —Read the Configuration Management Plan.
- —Read the Test Plan
- —Read the Software Subcontractor Management Plan.

11. *Pay close attention* to what they say about subcontractor management. Ask for their subcontractor management plan.

12. Watch out for *data rights* issues.

13. Look for front-end quality processes, like:
- —Design and code inspections
- —Complexity analysis *CASE* tools
- —Requirements generator *CASE* tools
- —Code generator *CASE* tools.

14. *CAUTION*: If they use the Integration and System Test phases as the primary time to find and fix software bugs, your system very probably will be late, will overrun cost, and probably will have unsatisfactory performance no matter what you do. If they skip Unit Test, expect big problems later, but ones that are, perhaps, not found until a disaster during operational test or actual use — *big* costs, and possible injuries.

15. Look for whether they design for maintainability.

16. If they say they use a development process, like design and code inspections, go back and ask them to describe it and how they use the results. Many contractors give lip-service to good processes but don't understand well enough to use them properly. Don't ever forget that no matter how good a proposal looks, more than 80 percent of the DOD contractors are software process capability *immature* (Initial level on SEI scale). It is one of the most, if not the most, serious hidden risks we face in contracting for software.

17. *CAUTION*: Software cost models are everywhere: COCOMO, REVIC, PRICE-S, etc. None of the results are worth anything if you can't get a good estimate of software size. All the models are dependent and results are biased by software size. Software size is a sensitive parameter. *Therefore*, for an unprecedented system, don't expect contractors to provide accurate cost proposals. They can't. Neither can we. Nor, can anyone else. The best software cost estimate will come from a technically-capable and process-mature contractor with a good database, who collects good metrics, and who had experience a few times. That probably means a contractor at the Defined level on the SEI scale. The process capability immature contractors don't have good databases, or databases with valid data for estimating cost. Even if they have a database, their immaturity biases the cost data.

What's All This Stuff About Metrics?

The DoDI 5000.2 requires using metrics in software management. It doesn't say how, which, when or what for. That's up to you. Congratulations! Metrics are only a number. Their only utility is in understanding the infor-

mation baggage that goes along with the number; the implications; what they tell you that *helps you make a decision. They answer a question for which you need an answer.* Don't look at metrics as isolated things; think in terms of sets of data that you use together to get a total picture of issues which need decisions.

Computing metrics for its own sake, or because something is measurable, or just to check-off a DoDI 5000.2 paragraph is a waste of time and money. Good contractors know this. Process capability immature contractors do not. Good contractors compute meaningful metrics as a matter of course because it helps them control their processes and make good decisions. They use metrics as a tool to achieve continuous improvement in their processes and control their technical efforts and costs. Process-immature contractors compute metrics because the government makes them; they whine, complain about the cost, and most don't understand implications of measurements they do take. They look at metrics as an unnecessary cost-driver.

Two fundamental types of metrics exist. These are generally classified as *management metrics* and *quality metrics*. Don't be confused by the nomenclature. Both are important to management and to technical personnel.

If the slope does not level off to a very low value by and after CDR, you're at big-time risk for meeting your threshold (forget about the objective). This junkyard dog can bite hard. When it does, effects often are unrecoverable.

Most metrics are utilized best when presented as trend data as opposed to point-in-time data. There are exceptions but this is a good general rule.

Metrics You Need for Any Development Program

Requirements Volatility. How rapidly are changes being made over time to software requirements? What is the rate of change? Plot the cumulative number of changes over time and watch the slope of that line. Do it for the entire program, and for each Computer Software Configuration Item (CSCI) independently. If the slope does not level off to a very low value by and after CDR, you're at *big-time risk* for meeting your threshold (forget about the objective). This junkyard dog can bite hard. When it does, effects often are unrecoverable. It throws you almost automatically into a cost-and-schedule problem. You and your contractor *must* manage this from *early on*.

Software Size and Size Growth Over Time. Disaggregate the data. Don't just look at total size, but also at the size dynamics of each component CSCI; also, each type of code (function and language). Keep track of these values separately for New Code, Reused Code and Modified Code. Understand the cost implication of changing the original projections of new, modified, and reused code. The total lines of code may not change, but if *new* code goes up, and *reused* code goes down, the cost will go up because it is more expensive to build and test new code than to reuse old code. Take continuous size projections at all life-cycle phases. The initial contractor estimates are usually low, often considerably low. You must match size growth projections against hardware capacity.

Personnel. Same sort of thing as software size. Track separately the changes for total personnel, but also the mix of experienced and inexperienced. Watch for changes near major review times.

Computer Attributes. What is the *capacity*? How is the software size growth affecting the hardware capacity? Require at least 50 percent reserve memory. Does the slope of the software growth curve make you nervous? If the memory reserve capacity drops below 30 percent, you *are* in trouble. It's no longer a future tense; no longer a risk; it has become a problem. What is the *processor speed*? Can the computer speed match software requirements?

Software Volatility. Don't worry about counting how many trouble reports you have open today. It's useless information. Rather, what is the rate of change for the software after Unit Test? Plot cumulative changes (trouble reports and requirements changes) over time for the whole system and for each CSCI independently; also by trouble report severity class. For trouble reports, *at the midpoint of the computer testing period*, or earlier, the slope of this cumulative curve should change rapidly and begin to approach zero as an asymptote. If it doesn't start doing that by the midpoint, you are in trouble. Get with your contractor and understand the problem. Is it in one CSCI, or is it system wide? Probably one or two CSCI. Work out a plan of recovery.

Complexity. Understand software complexity, especially Cyclomatic Complexity (also called McCabe's Complexity). It is a *very powerful* metric. Use a CASE tool to help analyze the code. Many analyzers can analyze Ada. If you have one that does, you can analyze the design as well as the code if you are using Ada as a program design language (PDL). Understand that when you compute the complexity number, this unitless number has 11 implications.

Eleven Implications of the Complexity Number

1. It is the exact number of independent paths through a software CSU (module).

2. It is the *minimum* number of test cases you must have to test each part of the module at least once, assuming the programmer recognizes the independent paths and develops separate tests for each independent path. (Some of the CASE tools automatically highlight the independent paths, and automatically compute the test conditions you need to test that path. All the programmer must do is copy the test conditions into the tests written.)

3. If the number goes above 10 for a module, the module begins to be error-prone.

4. The higher than 10 the module complexity number is, the higher the risk to the system from that module.

5. If the complexity for several modules goes above 30, get somewhat nervous and take corrective action.

6. If the complexity for several modules goes above 40, get *really* nervous and take strong corrective action.

7. If the complexity for several modules goes above 50, panic. A majority of the module paths will not be tested in Unit Test, or any later test; therefore, a significant percentage of the software will be delivered completely untouched by any test. This is an *enormous*, often-hidden risk to your system, especially if software failure could have life-threatening consequences.

8. Most process capability immature contractors don't understand anything about software complexity.

9. If a high-complexity module is in a critical path, especially a safety critical path, it is a time bomb waiting to explode.

10. Look at the complexity values for the entire system, and for each CSCI. Compute the average complexity but also look at the complexity distribution curve (a histogram). The average complexity can be deceiving. Look at how the module complexity values are distributed from lowest to highest values.

11. During computer-based testing, have the contractor compute the complexity and get complexity graphs, before and after each module change, intended to fix a trouble report. This is to ensure the change did not damage the module structure and drive up the complexity. This lengthens the lifetime utility of the module and lowers its total life-cycle cost.

Software Reliability. Watch out for this one. Make sure you understand the implications. Hardware reliability is a well-understood, valid and useful discipline. It is important in understanding maintainability issues and spare-parts provisioning. This reliability is usually computed as a mean time between failure (MTBF) or mean time to next failure (MTTF). These values have real meaning for hardware, and it says something about the hardware itself.

The MTBF is a measure of the expected time between failures of system components. If you have a fighter aircraft MTBF of 10 hours, and your average mission duration is 20 hours, you will not be able to fly a mission. We need this information for hardware to determine when to expect to change the hardware. We change hardware to get it back to its original condition, because it breaks. After you swap out the broken part, the old value of MTBF is still good.

For software, MTBF doesn't mean anything except in a gross sense. It may not be telling you anything meaningful about the software. There are many software reliability models that have been developed and work just like the hardware models. They are statistical Bayesian or Poisson models. They compute MTBF, which is supposed to be a measure of the expected time between failures. If you have an MTBF of 10 hours, what does this mean for software? Is it telling you anything about the software itself? Software doesn't break. You never change software to get it back to its original condition. Once you change software, the prior MTBF measure is no good.

From where does the data for software MTBF come? It comes from testing and operational use. Suppose you develop a mediocre test and run the software, and you get a certain number of errors. You enter this data into the reliability model and get a number that you think represents the reliability of the software being tested. Now develop a different, more stringent test and repeat the process. You get a different number of errors and, consequently, a different reliability number—same software, same model. Are you measuring the reliability of the software or the test you wrote? Once you know what data condition causes an error to manifest itself, you can cause the error to happen as often as you want by recreating that environment. Software is data environment responsive, and it reacts to data environments.

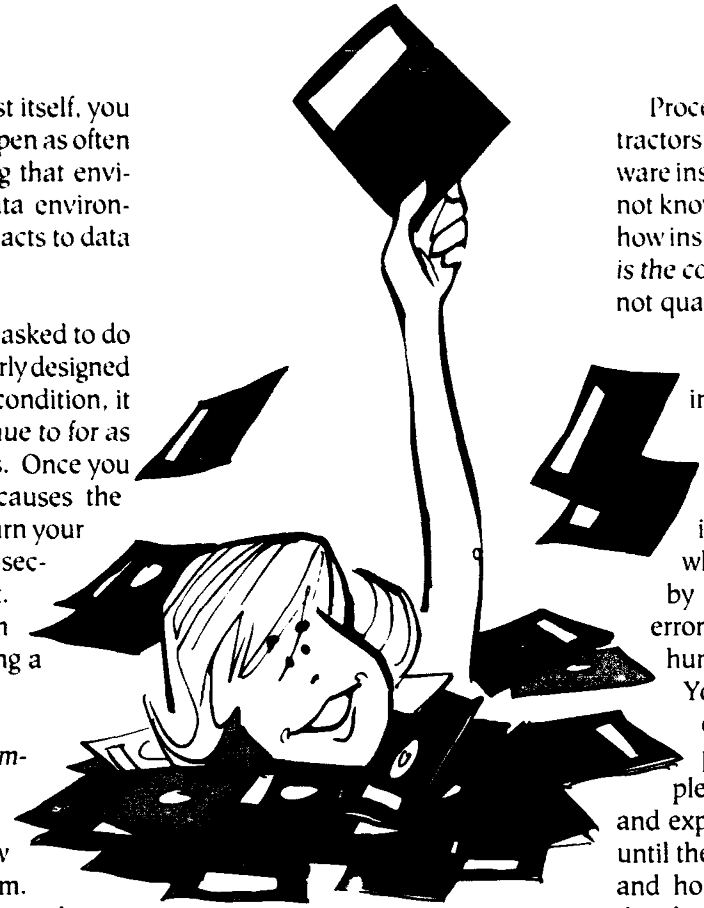
It will not fail until it is asked to do something it was not properly designed to do. Until you hit that condition, it works fine and will continue to for as long as the computer runs. Once you find the condition that causes the software to fail, you can turn your 10-hour MTBF into a one-second MTBF in a heartbeat. You don't want the system to hit that condition during a dogfight.

This is why *software complexity* is important. You must know the different software paths and know you have tested all of them. High-complexity modules impede your ability to do this, and unexpected operational software failure results. Properly using things like software complexity analysis is how you control software reliability; that is how you *manage* software reliability. Running an MTBF model is more of a diversion than a help.

Don't make the mistake of asking the contractor to give you a system-reliability number that is an arithmetic combination of hardware and software reliability numbers taken from statistical models. There is none. Conceptually, the two components are as different as comparing apples and oranges.

Managing Software Testing

Software testing should include human testing and computer-based testing. For process-immature contractors, it is usually confined to computer-based testing. Human testing is done before Unit Test. Computer-based testing is Unit Test, Integration Test, System Test, and all subsequent contractor and government software testing.



If you do good human testing, your computer-based testing processes will be controlled, manageable, and will give the management flexibility needed.

Human testing is desk checking (almost worthless); walk-throughs (can be good, but you never know in advance); and, software inspections (the best, with highly-consistent and predictable results). Inspections, when done properly, will remove a minimum of 70 percent of life-cycle defects from the software before Unit Test. Consequently, the traditional computer-based testing processes, instead of being the primary place to find and fix software errors, become a validation phase. *This makes your management* job orders-of-magnitude easier, more controlled, and gives you options you would never have otherwise.

Process capability immature contractors often have not heard of software inspections; if they have, they do not know how to do them properly, or how inspections can help. All they see *is the cost, not life-cycle payback* and not quality drivers.

If you do good human testing, your computer-based testing processes will be controlled, manageable, and will give the management flexibility needed. You can recognize when you have tested enough by the slope on the cumulative error detection graphs. Without human testing, all bets are off. You may be in a scrap continuously (and don't forget the 14.7 percent bad fixes); the complexity may grow continuously and exponentially; and, you will test until there is no time, money or both, and hope for the best to meet the threshold.

Put human testing in your RFP and contract for software intensive programs. After Unit Test, the contractor should have the software in a configuration-controlled test library, to which changes are made only with approval of the Software Change Control Board (SCCB), and made only by the Software Control group (not the programmers). Remember, Unit Test is the last test phase where the focus is inside the module. After Unit Test, the tests focus primarily on *interfaces*, between CSUs, between CSCs, between CSCIs, and between software and hardware. It may be an informal test, but its importance should never be underestimated.

Errors detected during tests using the configuration-controlled libraries should be categorized by severity. Have the contractor keep the error-detection rate charts for the total system, each severity type, each CSCI, and each severity type within each CSCI. Contractors need that data as much as you do, whether they realize it or not.

DSMC PAYS TRIBUTE TO DISABLED EMPLOYEES

"The Defense Systems Management College has taught me to reach for things that were [once] impossible."

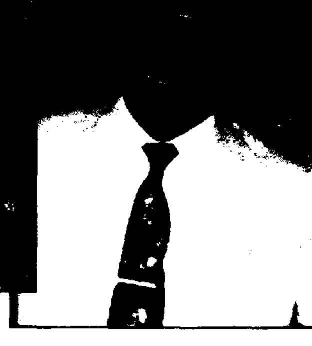
This comment by a Defense Systems Management College (DSMC) disabled employee aptly describes the support given the government's Disabled Employment Program by the College. Initially hiring individuals with disabilities in 1976, DSMC now has more disabled employees and volunteers than any other organization at Fort Belvoir.

A 1992 luncheon honoring DSMC disabled employees became an annual affair with a November 9, 1993, luncheon for eight full-time disabled employees and five disabled volunteers. Each received a time-in-service certificate and memento. Volunteers come from a nearby vocational high school and several local rehabilitation centers and receive valuable job and workplace experience at the College.

The DSMC provides the type of work environment volunteers need to obtain resume-quality experience. But, DSMC benefits considerably from the performance and productivity of these workers, especially during a period of Department of Defense cutbacks and downsizing.







From top, clockwise: Brig Gen (Sel.) Claude M. Bolton, Jr., USAF, DSMC Commandant, and Jeffrey Marble; Michelle M. McDonald; Michael M. King; Renita K. Janes; and Ellen K. Davidson.

The College strongly supports the Fort Belvoir Disabled Employment Program. Robert Ball, DSMC Press, a DSMC disabled employee, has represented the College on the Fort Belvoir Disabled Employment Program Committee since 1990. Mr. Ball and Cathy Pearson, of the DSMC Civilian Personnel Services Office, have received plaques in recognition of, dedication to, and support of the Post program.

The DSMC experience with disabled employees and volunteers proves that organizations and individuals reap significant benefits when there is a top-to-bottom positive attitude.

ROADMAP FOR MILSPEC REFORM

A National Imperative

Debra van Opstal

Ironically, one day we may look back upon the Cold War as a time of relative stability and containable risk, a time when the only major threat to world peace was that the two superpowers would annihilate each other. Today, risks are much more diverse and unpredictable. We are far less clear about who our enemies are and what they are capable of doing: a resurgent, hardline Russia; a belligerent China; rogue states, like Iraq, who have sizeable regional forces; the unholy nexus of terrorists; and drug kingpins who own the best in advanced technology that billions in laundered dollars can buy.

At such a time, the most comforting response would be to prepare for all contingencies. But, the reality is financial resources available for defense are declining. The Department of Defense (DOD) will not be able to subsidize a defense industrial base that can sustain U.S. readiness across-the-board. It must take advantage of existing research and development (R&D), engineering, and production capabilities to supply defense needs. The problem is that DOD has difficulty gaining access to the national industrial base.

Two major barriers stand in the way of integrating civilian and defense production. The first is legal and regulatory. Government contracts often impose unique terms and conditions, requiring information that commercial companies do not routinely collect or cannot certify with assurance. Companies typically respond to such requirements either by establishing special data management or administrative systems (which add cost and inefficiency) or by avoiding certain types of government contracts altogether. Because many of these requirements of government contracting are rooted in statute, Congress must act to remove these impediments to a more flexible industrial base.

Debra van Opstal is a Fellow in Science and Technology, Political Military Program, at the Center for Strategic and International Studies, Washington, D.C.

New Report on MILSPECS Released

A new Center for Strategic and International Studies (CSIS) report, *Roadmap for Milspec Reform: Integrating Commercial and Military Manufacturing*, describes the second barrier in detail. The DOD unique way of specifying its requirements, popularly known as the "MILSPEC" problem, often forces companies to create separate engineering and production lines for defense work when equivalent capabilities exist on the commercial side of the business.

The need for some type of specification is not really in question. All major buyers use them to describe the needed item (its form, fit and function) and the desired level of performance. Specifications are needed to allow the DOD to standardize on an existing product or service. They ensure that the Department does not procure 15 different iterations of the same part that are not interchangeable and require separate storage and support.

Specifications also attempt to guarantee lives are not lost because military equipment fails in the stress of combat, a goal borne of bitter past experience. In 1879, a column of 1,300 British soldiers was annihilated because their ammunition cases were screwed shut. In 1942, the German Army's 48th Panzer Division found that only 42 of the 104 tanks en route to Stalingrad could be moved; mice had eaten the insulation off the electrical wiring of the other tanks. In the South Pacific in World War II, U.S. supplies shipped to the area at enormous expense were corroded by fungus. Today, specifications ensure that ammunition boxes can be opened without tools, insulation is rodent proof, and fungus is not a threat.

The problem, then, does not reside with the principle of specification. Rather, the process by which specifications are developed and applied has become excessively rigid.

Requirements in new systems are not subject to rigorous cost performance trade-offs or dual-use considerations. One cannot design a weapons system and then expect to find its components commercially available or civilian factories to build it.

The *documents* that describe products or processes are flawed. Too often they describe commercial items in uniquely military ways, specify obsolete technologies or detail management practices that are not found in the commercial sector.

The *application* of uniquely military specifications is largely uncoordinated across the DOD. MILSPECs and standards are put in contracts even though the spec may have been canceled, replaced or superseded by an updated document.

The CSIS MILSPEC report deals with requirements, documents and application of documents with specific recommendations in each area.

Requirements

Military requirements have either been generated by user-pull or technology-push methods. Often the Services will identify a vulnerability that cannot be closed by changes in tactics or in strategy; it must be met with new equipment. At that point the technologists have free rein to design the new system to the "wish list" level of performance (and in order to get congressional support, it makes political sense to push the performance envelope as far as possible). The result is usually a weapons system with defense-unique features whose cost far exceeds real military value and which cannot be built on a dual-use production line.

Despite the exhortation to use existing product and process technologies to save cost, most new requirements packages are built totally without regard to whether they will require military-unique development and production rather than time- and cost-effective nondevelopment item (NDI) solutions, particularly commercial solutions. They are usually generated without the benefits of performance priorities and cost-performance trade-offs.

In 1942, the German Army's 48th Panzer Division found that only 42 of the 104 tanks en route to Stalingrad could be moved; mice had eaten the insulation off the electrical wiring of the other tanks.

Ironically, most of the elements needed to emphasize NDI procurement and cost-performance trade-offs are already in place. The problem is they don't work well and often not at all. Clearly, what is needed is a process that enforces the trade-offs among performance, cost and dual-use opportunities more aggressively. The CSIS Working Group on MILSPECs proposed to formalize specific evaluation criteria at Defense Acquisition Board (DAB) milestones one and two, in the review of Operations Requirements Documents as well as in the Request for Proposal (RFP) Review. Key criteria included:

—*Money*. Provide an up-front estimate of total dollars available for the program

—*Numbers*. Determine how many units will be needed to achieve force effectiveness

—*Priorities*. Prioritize performance characteristics

—*Justification*. Provide a solid rationale for each requirement in the system (a know-why benchmark)

—*Market Analysis*. Provide a thorough analysis of potential marketplace solutions, especially those that shrink the performance envelope to accommodate lower cost commercial solutions.

Improving Document Content

The phrase military specifications and standards refers to the 32,000 documents in the DOD Index of Specifications and Standards (DODISS) that are uniquely military. The other 17,000 documents in the index are composed of other types of specifications: commercial item descriptions, federal standards, and nongovernmental standards (e.g., commercial or international standards).

The DODISS is such a mixed bag of documents, it is impossible to arrive at any one silver bullet. Some specifications describe products that are available off-the-shelf, such as white gloves, tacos or hot dogs. There is no real reason to have specifications for such items. Indeed, they divert scarce resources from the task of drafting, reviewing and updating specifications for combat-related equipment. The Working Group recommended that these specifications be eliminated or converted to Commercial Item Descriptions.

Additionally, the DODISS includes a number of specifications — perhaps as high as 30 percent of the total documents — that describe obsolete technologies. The Working Group proposed a number of alternative ways to weed out these specifications: create a 7-year sunset clause on all documents; require coordination with industry users in the overage document review cycle; expand the electronic data feedback system to facilitate industry comment; and institute a new classification, "Inactive for New Design," for specifications that are obsolete but needed to maintain active systems.

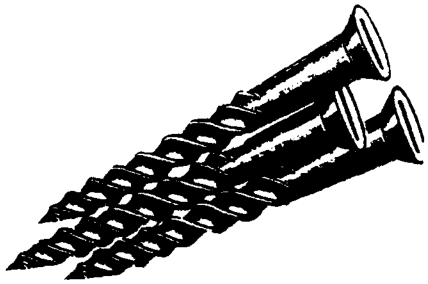
Complicated Problems

Probably the most complicated problems DOD must address are the process and management specifications. These specifications, commonly called standards, describe a management procedure or manufacturing process rather than a performance result. In describing precisely how the product is to be manufactured or quality assurance and reliability program is to be structured, or the work managed, DOD often precludes world class operations from applying their expertise and technological capability to defense needs.

These process standards have their roots in past failures — unreadable instrument displays, substandard packaging, products that failed too soon or were mismatched to the larger system. The problem today is that once a process standard is written and cited in a system design, it locks in a technology for all future contracts. Because that technology continues to evolve in the commercial sector, the specification will eventually be at odds with best commercial practice.

The real question is *why* DOD needs to tell contractors how to perform manufacturing processes instead of simply defining the end result in form, fit, function and performance terms. Management standards only guarantee that the compliance organization meets the spec, not that the product meets performance expectations. Manufacturing standards cannot keep pace with state-of the-art process improvements and are likely to become outmoded even more rapidly in a flexible manufacturing environment.

The Working Group suggested that DOD can explore alternative ways to



In 1879, a column of 1,300 British soldiers was annihilated because their ammunition cases were screwed shut.

ensure that its performance targets are met without imposing process requirements (e.g., use third-party certifications, acceptance testing, qualified manufacturer's certifications, nongovernment standards, or its own "ility" personnel to assess whether the contractor's system meets the performance goals).

Noting the urgency of reform measures in this area, the Committee recommended that all high-level or manufacturing standard should be converted to performance-based documents within 2 years. Any standard that has not been converted within that period should be made advisory only.

Application of Documents

The problem, unfortunately, is not limited to document content but includes how the documents are applied. The buyers of goods and services for the Defense Department do not hang their hats in one place; they are spread out organizationally and geographically. Although the documents may be standardized, the way they are referenced in contracts is not. That means that MILSPECs can be put on a contract even when they have been canceled or replaced. Or, a contracting officer might reference an entire MILSPEC when only a few sections are relevant to the immediate purchase. Even worse, that outdated or inappropriately referenced spec will flow down to all lower-tier suppliers. The bottom line is that even well-written, performance-based specifications can cause problems if they are not referenced or are improperly referenced.

The Working Group proposed that DOD should require program managers, or individuals responsible for authorizing purchases, to offer a rationale for the inclusion of uniquely military specifications or standards before they are put on contract. The Group recommended that waiver provision be provided in appropriate circumstances, such as, when the specification has been certified as being performance-based or when it describes a uniquely military characteristic (e.g., surviving electromagnetic impulses).

Finally, The Working Group noted one reason previous MILSPEC reform efforts failed was that they did not address the underlying lack of control of the standardization process by DOD management.

Lack of Budgetary Control

First, there is a lack of budgetary control. Although there is a substantial policy hierarchy for standardization activities within DOD and the Services, it has limited control of funding and manpower levels of the offices (preparing activities) that actually review, maintain, convert or update specifications in the DODISS.

Standardization is a corporate, not a field command, goal. When funds are allocated to field commands, it falls to the local commander to allocate those resources among competing priorities; for example, repairing the facility, maintaining manpower levels, developing specifications for new systems, or sifting through outdated ones to delete or modify them. Not surprisingly, the last tends to have a very low priority for the local commander (albeit a high priority for policy makers in the Office of the Secretary of Defense (OSD) who want to foster dual-use). There is no way to enforce corporate MILSPEC goals because there is no corporate control of the funding or manpower levels in the preparing activities.

The Working Group recommended that standardization activities be made a line item in the budget. Funding for local preparing activities should be funneled through the departmental standardization offices (DEPSOs) and allocated for support of standardization initiatives, training of personnel, conversion of "how-to" documents into performance-based standards or participation in internal or external workshops on standardization.

Metrics System

Second, DOD management has no system in place to measure whether its policy initiatives are actually being carried out. There are critical data elements that would track the progress of MILSPEC reform that are not currently available, such as the volume of commercial items being bought or the number of inventory items (national stock numbers) bought to military specifications as opposed to some other type of specification. The Working Group strongly recommended that DOD management put such a metric system in place.

The MILSPEC reform is more than just a desirable goal. It is a national imperative. Military specifications and standards affect most of the major policy issues in defense procurement today. They increase procurement costs and impede defense conversion efforts. Unique military specifications also hamper DOD access to the broader national industrial base. The new administration has promised to "reinvent government." Reinventing the way DOD does business offers one of the best places to start.

DSMC ADOPTS ALTERNATIVE SCHOOL

In the summer of 1993, the Defense Systems Management College (DSMC) entered into the Partners in Education Program with the Bryant Adult Alternative School. Fort Belvoir has seven adopted schools. The Partners in Education Program, a program sponsored by the Fairfax County, Va., public school system, provides the opportunity for the working community at Fort Belvoir to assist teachers and students in or outside the classroom.

The DSMC-adopted students, ranging in age from 17-23, dropped out of high school but, since, have realized the importance of a diploma and pursue its requirements at the Bryant School.

On campus, DSMC Professor Dan Robinson presented a workshop on TQM and leadership skills in the classroom, specifically for Bryant School teachers. Two other DSMC employees have given presentations to Bryant students. Ms. Myrna Bass of the Resource Learning Center presented "Self Esteem," and SFC Ivan Blanco, USA, discussed "Fitness vs. Drugs and Alcohol in your Life."

On November 18, 1993, 32 students toured seven different departments at DSMC. This tour will extend into student "job shadowing" with DSMC *employees at a later date. Job shadowing* provides a real-life, on-the-job experience for the student who has a career interest in a specific field.

Bryant School supplies DSMC with special requests for tutors, mentors and guest speakers. The DSMC also collects cash-register receipts from local grocery stores for classroom purchase of computers. When possible, software is transferred to the school.

Photo by Richard Mattox

Seated from left: Brig Gen (Sel.) Claude M. Bolton, Jr., USAF, DSMC Commandant; Robert Spillane, Superintendent, Fairfax County Schools; and Armand Sebastianelli, Principal, Bryant Adult Alternative School; with student.

GROUP DECISION SUPPORT SYSTEMS

Executive Team-Management Tools For the Military

Arnold N. Hafner

The progression of command and control (C^2) systems from message processors into executive decision support devices is the next generation of C^2 development. This evolution is being effected by user-developed prototypes and by the new architecture of Space and Electronic Warfare (SEW).

In a spontaneous manifestation of bottoms-up development, tactical decision aids, prototypes, and other user-developed desktop applications are coalescing into group decision support devices. In this regard, the Naval Tactical Command System-Afloat (NTCS-A) has joined several prototype devices (e.g., JOTS, NIPS, POST) into a comprehensive, LAN-based system.

Simultaneously, in a calculated application of top-down design, SEW architects have proposed networks of workstations supporting the management of sensors, information, electromagnetic-spectrum, and battle-space. This architecture mirrors the group decision-making practices of the Composite Warfare Command (CWC). A preliminary implementation of this design can be seen in the Advanced Track Management System (ATMS) baseline of the Interim Surveillance Direction System (SDS-I).

In both cases, command and control staff members are being equipped with decision support devices appropriate to their domains of expertise. Networking these processors aggregates the work of the staff and creates a decision support system for the group. Systems of this type will displace the C^2 technology of the past to become the Command Decision Support Systems (CDSS) of the future. This article provides a basis for understanding that future.

Background

Business and academia have studied group decision making and Group Decision Support Systems (GDSS) for at least a decade. The objective of this application has been to foster consensus among *ad hoc* groups of independent executives. In these systems, mechanisms for information input and opinion exchange are more fully matured than the mechanisms for alternatives generation and choice. On the other hand, the development of group support in the military has concentrated on generating and displaying alternatives to a seasoned staff.

Accordingly, one of the key differences between the business and military approaches to group support is the client group itself. The composition, tenure and policies of the group of users is as important a delimiter of performance as are the applications that are emphasized. While all groups of executives seek to assert autonomy over their domains, members of a military staff frequently exercise a virtual monopoly over their areas of interest. Since the practices and consensus mechanisms differ for the two groups, the functions of CDSS and GDSS differ.

The principal services of GDSS are the collection and ranking of ideas and the creation of an anonymous forum for discussion. The GDSS builders start with organizational behavior as an underlying discipline and approach decision making as a group dynamic. The objective is to foster consensus about a single, multifaceted subject.

The CDSS, on the other hand, start with military doctrine as their base and coordinate tactical decisions concerning different areas of warfare (e.g., air, surface, subsurface) The group dynamic of military leadership typically does not require that the decisions of a member of a command staff be negotiated. Rather, these are reconciled, *de facto*, by layering the resulting sets of intersecting directives.

Dr. Hafner is a Principal at Information Systems Research, San Diego, Calif. He holds a Ph.D. in leadership and human behavior and has 20 years of experience as a practitioner of systems analysis. He has published more than 30 papers in the fields of command and control and decision support technology.

The result is a composite of various warfare-area decisions which are presented to the commander as an ever-changing collage of large screen displays.

Because of this group behavior, CDSS efforts, to date, have centered around creating decision support tools for the individual staff officers and on displaying the results generated by these DSS. The interpersonal and organizational implications for group dynamics are yet to be explored. If CDSS evolution is to avoid the pitfalls[1] of the C^2 experience, analysis and application of these behavioral disciplines is required.

The existing, prototype-based CDSS systems offer ample opportunity for beginning these analyses and this article provides its intellectual basis. It explores the origins of decision support technology and the hierarchical characteristics of decision making. It discusses the military application of single-user systems as tools for alternatives generation and analysis. It offers definition of a group support system for the military (i.e., CDSS) and offers recommendations for implementing behavioral research in the development of CDSS.

Evolution of the Three Types of Computer-Based Information Systems

Three broad categories of Computer-Based Information Systems (CBIS) have evolved in response to requirements for successively complex output. Those that process transactions are the simplest and those that enhance decisions are the most complex and the newest.

Starting as sophisticated mathematical tools at universities, computers migrated to the lowest level of business to support transaction processing. Then, in response to the needs of midmanagement, the next level of CBIS emerged as computers began aggregating transaction statistics for administrators. Finally, CBIS are be-

Disdaining straightforward mathematical applications, the military is applying decision support to information fusion and to the subjective evaluation of tactical alternatives.

ginning to provide interactive support for decision making at the executive level.

The military use of computers has followed a similar progression but with different application foci. Knowledge of these divergent applications can be an important tool for understanding the newest CBIS and for guiding the future growth of both. Figure 1, illustrates this parallel development by contrasting the business and military applications of CBIS with the products each produces. From this figure, it can be seen that business applications initially were straightforward manipulations of data from financial events (e.g., payroll, sales, inventory). Likewise, the first military applications (though delayed several years while discreet mathematics was perfected) were also dependent on straightforward mathematical processes.

Next, commercial applications focused on presenting summaries of transaction data to midmanagement and the technology of Management of Information Systems (MIS) was created. The military applied CBIS technology to message transmission and the C^2 System emerged. Commercial applications of MIS moved toward tools for simulation and the military perfected its message integration mechanisms.

The legacy of simulators is the Decision Support System (DSS), which offers executives the ability to observe effects of *ad hoc* simulations. Consistent with its historical concentration on the mathematics of accounting, the DSS has been used as a financial planner[2] in business for several years. The military, on the other hand, is concentrating on more esoteric applications of decision support. Disdaining straightforward mathematical applications, the military is applying decision support to information fusion and to the subjective evaluation of tactical alternatives.

Although the field is just emerging,[3] the DSS is sometimes incorrectly called a Tactical Decision Aid (TDA) in the military. The term "DSS" implies a system with libraries of algorithms;

FIGURE 1. The Evolution of Computer-Based Information Systems

Generic CBIS/MIL Name	Commercial Application	Military Application	CBIS / MIL SYS Output
Decision Support Systems / Tactical Decision Aids (ca. 1985)	Financial Planners	Tactical Command	Financial Plans / Battle Plans
Management Information System / C2 (ca. 1975)	Summary Reports	Message Processing	Budget Synopsis / Message Fusion
Transaction Processing System/Sensors (ca. 1965)	Payroll Processing	Weapons Control	Paychecks / Projectiles

FIGURE 2. The Hierarchical Characteristics of Decision Making

Management Activity	Activity Orientation	Data			Decision			CBIS Tool
		Sources	Format	Currency	Situation	Process	Criteria	
Mission Management (Commander)	Achieve Mission Goals	National	Correlated	Non-Real-Time	Unique	Unstructured	Satisficing	DSS / TDA (CDSS ?)
Task Management (Watch Officer)	Allocate & Employ Resources	Mixed Sources	Fused	↑	↑	↑	↑	↑ MIS / C2 ↑
Operational Control (Enlisted)	Decipher Sensor Data	Sensor	Detailed	Real-Time	Recurring	Structured	Optimizing	TPS / SNSR

whereas, TDAs tend to be unique singular algorithms. There is library of TDAs at NADC Pennsylvania where users can obtain configuration controlled programs for use with navigation problems. Exemplified by the Electronic Warfare Commander's Module (EWCM), military DSSs employ abstractions that are not found in the mathematics of financial DSS. These methods of qualitative analysis and the formulation and evaluation of choices offers considerable challenge.[4] This is particularly so in areas of organizational and human behavior where the process of decision making is poorly understood.

Hierarchical Characteristics of Decision Making

Not surprisingly, the hierarchy of computer-based information systems is strikingly similar to the structure of organizational decision making. Figure 2 projects the three types of computer-based information systems onto a typical military hierarchy. The left side shows the management activity of a command hierarchy juxtaposed against the information management tool with which they are performed (right side). The middle three columns illustrate: (1) the management activity the user is performing while applying his CBIS tools; (2) a description of the data used by the CBIS; and (3) the parameters of decision making within which decisions must be reached.

As one ascends the hierarchy of management activity and tools, the data from which decisions must be made become less defined and less current. At the transaction level, (e.g., a radar) the information for making a decision is specific and generally real-time. At the opposite end of the hierarchy, upper management deals with information that is non-real-time, has been collected from many sources (i.e., correlated), and originates at locations outside the command. Similarly, the parameters within which decisions must be made become less definitive as one ascends the management hierarchy. The structured, repetitive, optimized decisions the operator makes are replaced by decisions about unique situations that the commander must make using unstructured processes (e.g., instinctively). More often than not, these decisions are made using a decision criteria known as "Satisficing."

This point is easier to grasp in counterpoise with the lowest level of decision making: The bulk of organizational data originates at the operator (i.e., the transaction) level. Here succinct, well-defined optimization criteria, discreet parameters, and well-known solution techniques can usually be solved with linear algorithms. Since this type of computation lends itself to computer modeling, it is not surprising that the transaction level was the first to be automated.

At the level above the operator, where methods of solving the problem are less structured, decision making algorithms are more obscure and descriptive modeling is common. In business, this type of midmanagement decision is often couched in terms of performance differentials (e.g., "...10% above FY '90 consumption levels for...."). The comparable military system, the C[2] system, generally does not offer such modeling.

As has been observed, the origins of C[2] led these systems to mature along a path more attuned to message processing and retrieval than to data summarization. Tracking algorithms and data correlation models have been built into latter-day C[2] systems such as the Flag Data Display System (FDDS). Military leaders should learn to use these applications as tools of analysis rather than for the "truth" of their output.

At its most sophisticated, the decision process is unstructured. Its selection criterion are more attuned to the time constraints associated with making a choice than to the confidence in those decisions. The DSS is a tool for individual decision makers and serves this type of choosing. The circumstances of these decisions are unique and the processes of selection are primarily intuitive. They are typically the prerogative of people who have considerable organizational authority and autonomy in their actions.

The hierarchical structure of organizational decision making complements the history of computer-based information systems. Likewise, an appreciation of the functions of an individual DSS presages the definition of the emerging CDSS application.

DSS: The Single-Person Decision Tool

The DSS, a device that supports a single decision maker, has been defined as:

> A man-machine couple that facilitates the incorporation of experience and instinct in decision-making. It allows the application of *ad hoc* simulations as a medium for hypothecation

('what if-ing?') and automated goal-seeking in the solution of complex, non-structured problems.[5]

Understanding these systems requires an appreciation of the intellectual impetus they can provide. The utility of decision support is the stimulation that successive iterations of machine-generated data can provide to the creativity of the human partner of the man-machine couple. In such a partnership, the function of the machine component is data recall and *ad hoc* data manipulation.

Data manipulation involves the selective use of applications modules (e.g., Markov Analysis, Filters, Spectrum Prediction) and the choice of models is the contribution of the human component. This choice is based on human insight and experience and upon the operator's interpretation of the latest iteration of the data. The breakthrough that DSS portends is the enhancement of the synergy between the optimal capabilities of each of its man-machine components. The use of DSS requires enculturation, as the users of existing prototype-based systems are beginning to appreciate.

The basic components of a generic DSS are illustrated in Figure 3. This illustration suggests a standard set of operational processes and a customized set of application modules. This design permits standard man-machine interface and operations while providing each warfare specialist with a unique set of applications modules.

Communications, text and graphics display, screen processing, a rule-based expert system, model-base management system, and database management modules should all be standard modules. Sets of applications programs for management of the electromagnetic environment, sensors (i.e., undersea, surface and space), tracking, information fusion, data correlation and intelligence filtering should be available optionally.

The utility of decision support is the stimulation that successive iterations of machine-generated data can provide to the creativity of the human partner of the man-machine couple.

As illustrated, centralized database and model-base facilities host the common data and the library of applications modules. Model-base management facilities,[6] a new software management process for joining the input and output of dissimilar decision aids, will most probably be required.

Toward a Definition of Multi-Person Decision Support Systems

Group Decision Support System (GDSS) development, generally sponsored by university research, emphasizes facilitation of the decision process within a group. This work is slowly developing a taxonomy of group decision support but, with the possible exception of Kraemer, it generally neglects the military applications. This section briefly explores the emerging taxonomy as a foundation for an initial definition of CDSS.

Academic publications generally treat group decision support as follows:

> ...Integrated computer-based systems which facilitate solution of semi- or unstructured problems by a group that has joint responsibility for making the decision (Gallupe, 1985), and...the application of information technology to support the work of groups with a focus on improving group performance and organizational effectiveness (NFS Working Group). Vogel observes: Overall, GDSS are now recognized as supporting searching for alternatives, communication, deliberation, planning, problem solving, negotiation, consensus building, and vision sharing, as well as decision making for group members not in the same room at the same time.[7]

These perspectives appear to envision embedded decision aid modules for use in "what-if'ing" but it is not clear from the literature that they do so

FIGURE 3. A Generic Decision Support Workstation

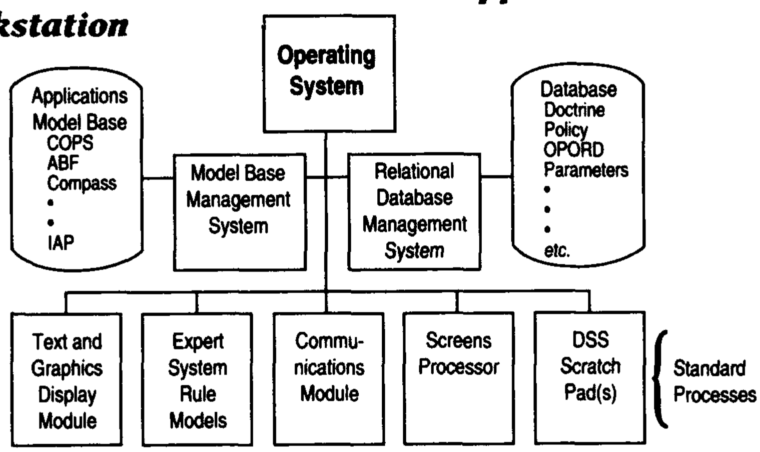
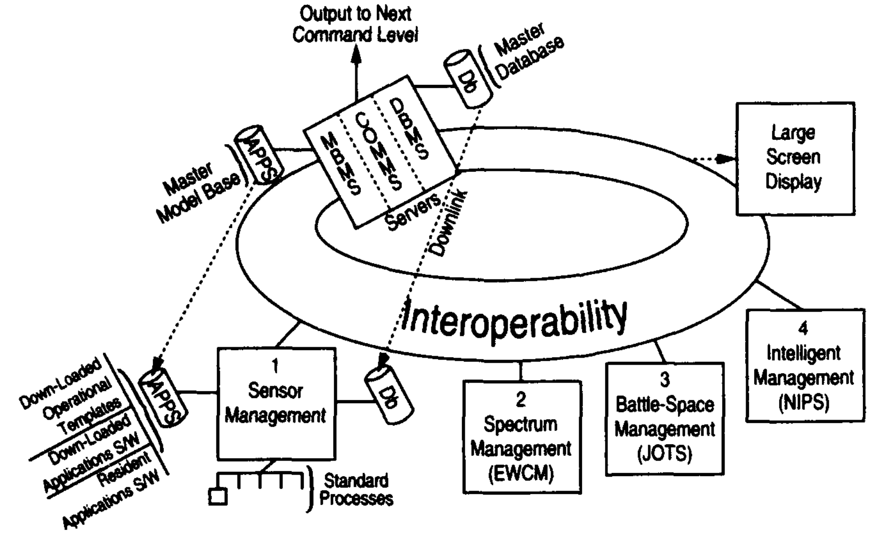


FIGURE 4. A Network of Integrated Workstations



to the same extent as military CDSS. Pinsonneault and Kraemer offer a further classification. They differentiate systems that support intragroup communications, Group Communications Support Systems, from those that support group decision making (i.e., GDSS).

It is their definition of the GDSS device that is most useful because it closely approaches the salient aspects of military applications:

> ...those systems that attempt to structure the group decision process in some way...can support member's individual decision processes through decision models. This basically corresponds to applying Decision Support Systems (DSS) to groups without supporting the group process per se. Here the technology supports [the] decision processes of individuals working in a group.[8]

This is a more appropriate description for the military. As we have seen, the command structure of a battle staff diminishes the need for consensus mechanisms. Also, the decision aids in existing applications tend to emphasize user-machine interaction and recursive calculation without regard for group participation. The Tactical Flag Command Center, a C^2 system that is being upgraded with new tracking and correlation processes, appears to conform to this definition.

The CDSS prototypes that are available also appear to support the definition. Figure 4 is based on the ATMS model and shows independent workstations distributed across a network controlled by database, communications and model-base servers. The workstations represent existing prototypes for the management of (1) Sensors, (2) Electromagnetics, (3) Battlespace, and (4) Intelligence.

This illustration shows applications software, representing tactical decision aids and operational doctrine, being provided to the workstations from a central repository (i.e., the model-base). This could occur on an *ad hoc* basis according to the needs of each warfare-area staff member and are called Optional Application Tapes (OATs) in the "Unified-Build" of JOTS. Recognizing that members of a Command Staff are experts in their warfare-areas, some might prefer to supply their own personal library of applications (e.g., floppy diskettes). These might contain the algorithms and applications modules that were used during training or on other staffs. The model-base management system will accommodate such a scheme. Finally, a large screen display (i.e., the commander's console) represents the military integration medium in which the decisions of the warfare staff are reconciled.

The various similarities between GDSS and CDSS suggest consistency in the research approach to group support. However, the differences between business and military leadership suggests a more interesting possibility. As a comparator, the military rank structure and staff processes (e.g., "management by exception," "silence means consent") can offer an interesting research counterpoise to existing academic research into consensus management. This cross-comparison will accelerate technology transfer between the GDSS and CDSS technical approaches.

Guiding the Development of CDSS with Operational Analysis

Existing CDSS are principally aggregates of user-sponsored decision aids that are being back-fit into existing command and control suites. As collections of user developed devices, the modules are relatively self-contained and provincial. Interleaving the decisions that are facilitated by these tools is effected (presumably) by the delimitation of the warfare-areas and by the ultimate authority of the senior officer.

Accordingly, existing CDSS are simultaneously groups of individual DSS workstations and a single tool for a commander. Notwithstanding the goals of leadership precepts, the commander manipulates these elements according to behavioral considerations (among other things). These interpersonal mechanisms should be implicit in the design of the CDSS but they are not. Speaking of contemporary systems development efforts, Huschheim observes:

> *Research into IS failure has concluded that the primary cause of failure is the lack of consideration given to the social and behavioral dimension of IS....A growing num-*

ber of researchers suggest that information systems are more appropriately conceived as social systems which rely, to a greater and greater extent, on new technology for their operation.[9]

The spontaneous evolution of CDSS, like the eruption of C^2 from its origins in message handling, neglects this important consideration.

These behavioral tactics come into play in various potential CDSS domains. One domain is the intelligence field where emphasis on the integration of intelligence materiel into the platform command process is increasing. As CDSS emerge in response to the perceived need for closer coupling between the platforms and information sources (including sensors), operational studies could help to achieve organizationally workable linkages.

Under the SEW concept, command systems are under consideration that support new ASW tactics at as many as three command echelons (e.g., the Theatre/Region/Sector). To be useful across so broad a management spectrum, information fusion and data correlation requires a significant amount of judgmental activity. As this implies human interaction with the data as it matures into information, it is a mandate for anticipating the effect of human behavior upon choosing. Clearly, organizational characteristics such as authority and procedures also will impact this process.

Finally, systems have been built traditionally from a full knowledge of the practices and procedures under which they will be employed. At present, the operational and command relationships of the new ASW and SEW prosecution mechanisms are not yet established. What *is* apparent at this time is that combat decision support will require systems that have a decentralized architecture of distributed, parallel processes operating in an environment of intensely interactive command. This will demand a higher level of interpersonal interaction among remote participants than has yet been achieved anywhere. Without *a-priori* consideration of the command relationships, communications channels are likely to be flooded with irrelevant coordinating data.

The CDSS that will respond to these challenges will be distributed systems whose operator-machine components process-in-parallel and decide-in-concert.

The CDSS that will respond to these challenges will be distributed systems whose operator-machine components process-in-parallel and decide-in-concert. Spatially distributed teamwork in manufacturing information is increasingly important and mechanically harder to achieve. Behavioral and organizational considerations are a major factor in the operation of such distributed systems and can be expected to become a major aspect of the new designs.

A new Navy laboratory, which is demonstrating collections of fleet prototypes,[10] has the potential for investigating these new concepts of information integration. Through the studies at this center, the definition of teamwork mechanisms for information integration can become an important advance in the development of CDSS.

Endnotes

1. Hafner, A., "The Punched-Paper-Tape Legacy of Military Information Systems," *SIGNAL: Journal of the Armed Forces Communications Electronics Association*, Burke, Va., December 1987.
2. Integrated Financial Planning System (IFPS), Execucom Corp., Austin, Texas, ca. 1984.
3. The Emergence of Decision Support Technology in Military Information Management Systems," *Program Manager*, Journal of the Defense Systems Management College, Fort Belvoir, Va., July-August 1986.
4. Kahneman, D., Tversky, A., "Prospect Theory: An Analysis of Decisions Under Risk," pp. 263-291, *Econometrica*, Vol. 42, No. 2, March 1979.
5. Hafner, A.N., "EW Decision Support Technology," *Journal of Electronic Defense*, Arlington, Va., October 1986.
6. Peng-Liang, "A Graph Based Approach to Model Management," Proceedings, International Conference on Information Systems, Society of Information Management, S.D. CA, December 1986.
7. Vogel, D., Nunnamaker, J., "Group Decision Support System Impact: Multi-Methodological Exploration," *Information & Management*, Elsevier Science, Amsterdam, Netherlands, January 1990.
8. Pinsonneault, A., Kraemer, K., "Impact of Technological Support of Groups: An Assessment of the Empirical Research," Decision Support Systems, Elsevier Science, Amsterdam, Netherlands, May, 1989.
9. Jarke, M. (ed.), Managers, Micros and Mainframes, John Wiley & Sons, 1986.
10. "New Models - New Methods." *Program Manager*, Journal of the Defense Systems Management College, Fort Belvoir, Va., May-June 1991.

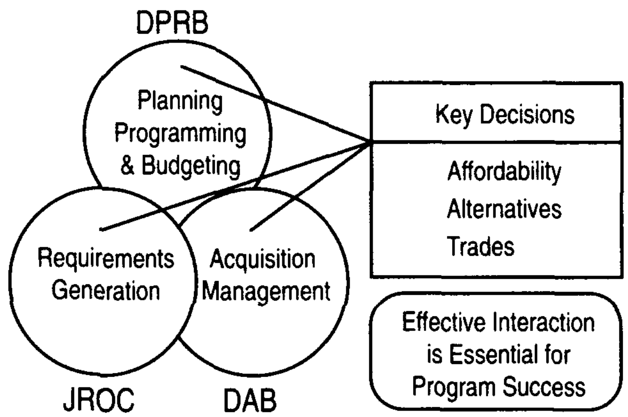
LESSONS LEARNED/BEST PRACTICES

DAB Milestone Reviews

Lt Col Lawrence E. Sweeney, USAF
R. Ross Hosse
Kent White

In this article we share with the defense program management community our experiences at Electronic Systems Center (ESC) related to Defense Acquisition Board (DAB) activity. While the scope of this writing is limited to some broad issues and generalities, we believe this article will be a useful source of reference for everyone facing a DAB decision during their careers. An important fact to keep in mind when facing a DAB decision is — *They Are All Different!*

FIGURE 1. Three Systems Interconnectivity



(Figure from DSMC briefing given by Rich Stillman, Eastern Region Director.)

DAB Process and Milestone Review Procedures

Three systems that overlap and must interact effectively in order to attain success are the Planning Programming and Budgeting system (PPBS), the Requirements Generation System, and the Acquisition Management System. The PPBS is subject to the Defense Planning Resources Board (DPRB), the requirements generation process to the Joint Requirements Oversight Council (JROC), and the DAB governs the acquisition management process. Key decisions are based on affordability, alternatives and tradeoffs. Figure 1 shows the relationships of the three systems.

An overall understanding of these three systems and their interconnectivity is imperative if one intends to navigate the choppy waters associated with a milestone review. The primary source of reference is Department of Defense Instruction (DODI) 5000.2, "Defense Acquisition Management Policies and Procedures." This Instruction will be your guidebook for the following:

—Acquisition Process and Procedures
—Requirements Evolution and Affordability
—Acquisition Planning and Risk Management
—Engineering and Manufacturing
—Logistics and Other Infrastructure
—Test and Evaluation
—Configuration and Data Management
—Business Management and Contracts
—Program Control and Review
—Special Situations
—Defense Acquisition Board Process.

Lt Col Sweeney has participated in five DABs and was the Deputy Program Director for Business Management for the Space and Missile Warning Program Office at Electronic Systems Center (ESC), Hanscom AFB, Mass. Mr. Hosse was the DAB coordinator reporting to Lt Col Sweeney for the Cheyenne Mountain Upgrade (CMU) Program under the Space and Missile Warning Program Office at ESC. Mr. White headed the support contractor team from CTA Inc., for both the 1989 and 1992 CMU DABs.

You should become intimately familiar with the last item on this list as soon as possible if there is a remote chance you will face a milestone review. Figure 2 lays out a generic flow for typical milestone reviews and can be used as a rule of thumb. The Office of the Secretary of Defense (OSD) and Air Force reviews (see acquisition review process) are listed separately in order for you to view the two distinctively, realizing both will be prepared for concurrently. We have used the Air Force Review Process here as an example because of our familiarity with the process; however, we are confident you can substitute other respective Service review processes for the Air Force approach with little difficulty.

Lessons Learned

The lessons learned are related directly to the formal service and DOD reviews along with the documentation required. The first step is to review thoroughly the processes and procedures necessary to allow for a DAB decision. The "Defense Acquisition Board Process" is found in DODI 5000.2; Part 13 and "Milestone Review Procedures and Documentation" are located in DODI 5000.2, Part 11, Section C. In addition to the familiarization with these areas of the DODIs, we found it absolutely necessary to review all prior DAB assessments, reports, action items, etc., related to our programs. For example, we reviewed prior Cost Analysis Improvement Group (CAIG) reports, Air Force Systems Acquisition Review Council (AFSARC) Implementors, Program Assessments, Documentation Memos, Acquisition Decision Memos (ADMs), Test and Evaluation (T&E) Reports, Planning Meeting Memos, and Acquisition Strategy documents.

Major Issues Guidance Document

This document should be published by OSD seven days following the planning meeting. The Draft Integrated Program Summary (IPS), the primary decision document for the DAB, will be published about 105 days after the Major Issues Guidance Document is released. This document identifies issues pertaining to exit criteria and establishes minimum program accomplishments for presentation to the DAB.

Lessons Learned/Best Practices

—Focus on producing a draft of the IPS as quickly as possible after the planning meeting. Coordinate in parallel and work any issues and any changes in real time. This will take some effort but if you stay a step ahead and coordinate your approach prior to the program review meetings, things will go more smoothly than you think.

—Seek consensus on issues before guidance is released. Make some calls, send some faxes, and ensure you have Service and user agreements, in principle, on the issues. If the user will not support your position, you have a problem.

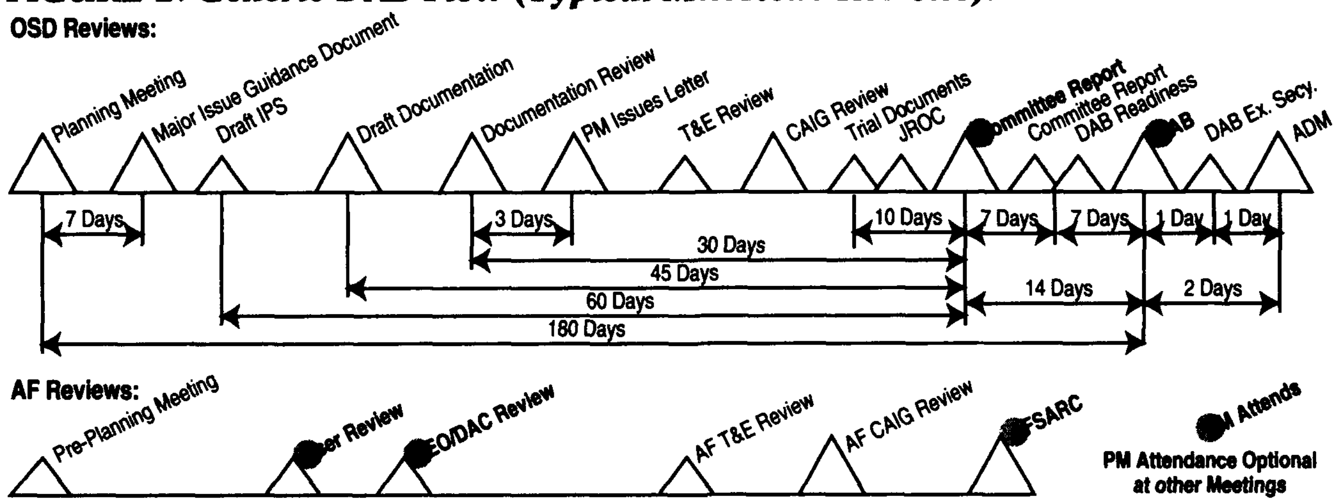
—The Major Issues Guidance Document becomes a benchmark for all subsequent reviews in the milestone review. Deal with the major issues early because you'll find even if the issue goes away, the questions won't.

Draft Documentation Submission

This documentation is not yet approved by the Milestone Decision Authority, but is approved by the Service. From a program manager's perspec-

Deal with the major issues early because you'll find even if the issue goes away, the questions won't.

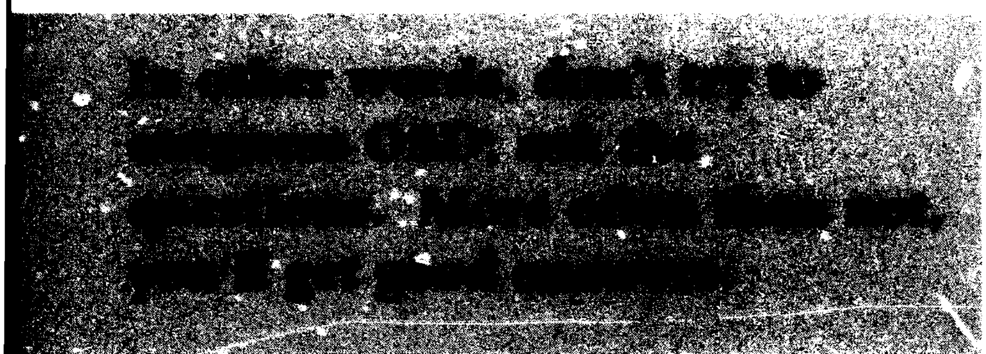
FIGURE 2. Generic DAB Flow (Typical Milestone Reviews).



tive, this is the final draft. All documentation must be approved by the Service and copies are provided to the OSD action officer. The due date is 45 days before the respective committee review and the review date will slip if the documents don't come in on time.

Lessons Learned/Best Practices

—Ensure proper lead time for Service coordination. Run a Program Evaluation Review Technique (PERT) analysis with an optimistic, pessimistic and modal time. The time it will take will most likely fall somewhere

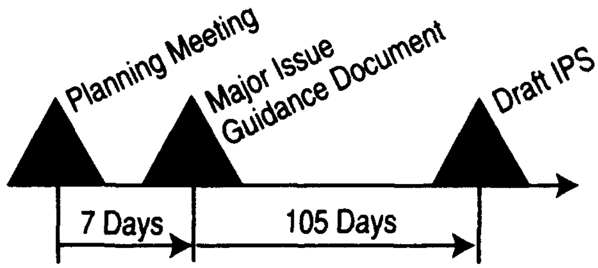


in-between the two extremes. Alleviate undue stress and simply do a little up-front planning.

—Provide a program acronym listing. This courtesy will pay dividends. All of us have our Service, command and program specific language. Make it easy on the reader and things will probably be easier for you.

—Establish configuration control procedures and keep an audit trail of all changes to the documents. Devise a documentation matrix to cross-check information consistency. Things can get hectic but without proper change controls, you've got chaos. For example, someone's opinion may slip in that it contradicts the program director's recently coordinated position. It's easier to change it back than to search for the guilty party. Also, with a matrix, you can ensure changes are made that apply to more than one document.

FIGURE 3. Document After Planning Meeting



—Where possible, precoordinate with OSD staff offices months in advance to ensure the approach and content are satisfactory at least in principle. It is understood that your Service may be hesitant to release a less than fully coordinated Service position; however, discuss the information that is common knowledge and see if you can reach early agreements on the format and approach to prevent unnecessary rework. In other words, don't try to outguess OSD; ask the questions. More often than not, you'll get good answers.

—Make sure the documentation answers the Major Issues Guidance. This may sound overly simplistic, but be absolutely sure you've answered the mail.

Test and Evaluation Review

The Test and Evaluation Master Plan (TEMP) is reviewed with the DOD director of operational testing and the DDR&E director of developmental testing. This plan lists critical test objectives and outlines the test approach and methodologies. The review objective, from a program manager's viewpoint, is to obtain TEMP approval.

Lessons Learned/Best Practices

—The entire review cycle is a lengthy process, so start early. Numerous agencies must coordinate and this can take feasibly 9-12 months to complete.

—Work closely with AF, OSD and AFOTEC staff offices throughout the process.

—Seek consensus and work to resolve issues early. As soon as issues arise, get on the phone, write point papers, or send correspondence. Communicate well and try to reduce the possibility of issues getting out of hand; keep them solvable.

—A "red-line" session as soon as possible is suggested for the draft TEMP, with as many coordination agencies. Face-to-face communication can head off or resolve issues quickly.

Documentation Review

This review takes place two weeks after draft documentation submission and is chaired by the OSD oversight office (OSD action officer). Representatives for all OSD committee principles and DOD components attend. Major questions or issues raised by the documentation are identified and reviewed, and new program developments are focused on. The final result is a documentation review memo to the Service acquisition executive.

Lessons Learned/Best Practices

—This review is an ideal opportunity to focus an issue resolution. Close as many issues as possible.

—Communication is key. Seek a clear understanding of comments received, which should be provided in writing.

—The user rather than the system program director should brief requirements.

—Help OSD draft the documentation review memo by recapping the issues and categorizing them into three areas — major issues, minor issues and documentation comments.

Committee Review

This review ensures exit criteria are met and program accomplishments are completed. The committee reviews all issues and provides an Integrated Program Assessment to the DAB Principles. The committee also provides a "read-ahead" (one-page issue summaries of all documents) and recommends issues to the DAB. This is the most critical of all pre-DAB reviews and occurs approximately 14 days prior to the DAB.

Lessons Learned/Best Practices

—The program manager usually briefs the Integrated Program Summary and actions to resolve major issues. From the time the draft documents are submitted, all discussions should focus on resolving major issues. Issue resolution should address cost, schedule and performance parameters, including risk-management decisions and affordability trade-offs.

—The committee's purpose is to make recommendations concerning the merits of proceeding with the program and the exit criteria for the next review. If the process is working correctly, the recommendations here should come as no surprise.

A Few Words of Advice from Our DAB Experiences

—As your team progresses through the process, focus on remaining roadblocks so progress is continuous. Make sure you keep moving forward.

—Provide your DAB coordinator with authority and make it clear to the troops that the DAB is a highly important exercise and everyone's help is required — move it to the top of the program office priorities.

—Keep everyone informed and quickly coordinate fast-breaking news.

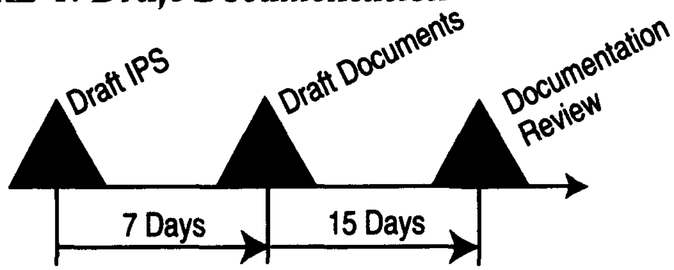
—Build a "can do" attitude in your team. The DAB process is no easy task and you won't be able to promise a painless process, but you can motivate people and reward the small and more grand accomplishments. Remember, the DAB is a 1-2 hour briefing that is really a culmination of many smaller accomplishments.

—Use experts whenever possible. You'll save time and effort if you have the expert with you to head off questions and clarify issues.

—Be as proactive as possible and ask for advice. Seek out people who have been through the process, see your DSMC regional director, and call anyone you think can offer help.

—Finally, keep an open mind, a good sense of humor, stay flexible, and take your vitamins — you're going to need the energy.

FIGURE 4. Draft Documentation



DSMC JOINS THE INTERNET

The Defense Systems Management College is in the midst of a major program to upgrade the automation facilities for staff, faculty and students. Named the Electronic Campus Project, the future systems at DSMC will improve the College computing capabilities and will allow students to maintain contact with the faculty after graduation. Classrooms will have new computers with CD-ROM players, campus network access, and the latest office automation software. The DSMC library will have a new system with improved cataloging and on-line access to information services. When the Electronic Campus is completed, a fiber optic backbone network will interconnect automation assets throughout the campus.

In January 1994, the DSMC Electronic Campus e-mail system was integrated initially into the MILNET and the Internet. As the Electronic Campus grows during 1994, eventually everyone on campus will have worldwide access via e-mail. When the Electronic Campus Project is completed, full Internet services, including TELNET and FTP, will be available. Additionally, a bulletin board system, open for public use and focused on acquisition and program management information, will be installed.

The Internet e-mail addresses at DSMC are of the form username@dsmc.dsm.mil, where username is normally a person's last name and first initial. All DSMC staff and faculty will be registered in the MILNET, so savvy users can use the WHOIS service on MILNET to look up names and e-mail addresses. The DSMC host computer is a Sun Microsystems Model 4-370, and the IP address is 198.97.207.254.

For assistance with the DSMC Electronic Campus, contact LTC Bert Garcia, USA, (703) 805-3462, or via e-mail at garciab@dsmc.dsm.mil.

GLIDING INTO HISTORY

TWO PROPELLERS SHORT OF A PLANE:

The American Introduction of Gliders Into Combat in Sicily, 1943

Captain Hadd Jones, USAF

Acquisition professionals have much to gain from studying the past. We are busy with programs valued at millions or billions of dollars and are concerned about executing them successfully. Defense acquisition has played an important role in 20th Century American history.

The most dramatic transformations in the American political economy have occurred during wars. The military plays a significant role in mobilizing the nation's resources for war and, in the cases of the two world wars, no sector of the economy escaped government interference.

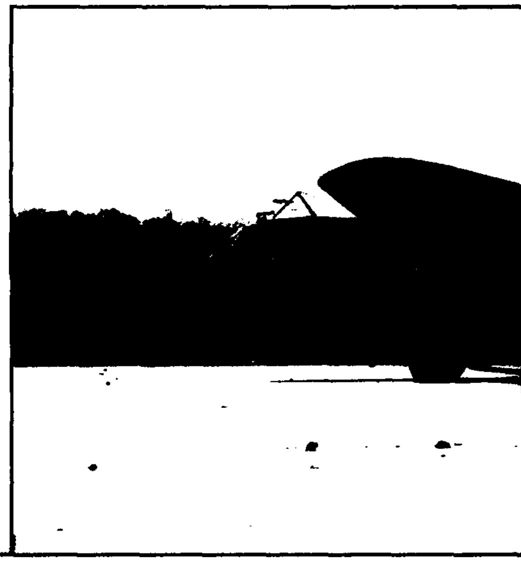
As we fulfill our responsibilities in peacetime, we should understand the actual and potential consequences of our actions. Studying myriad ways the government and, more specifically the military, injected itself into the American economy is a daunting task, especially if one considers America in the 1900s. My goal is more limited. This article provides an example of the importance of ideas in military and economic affairs by using a case study from World War II (WW II).

Captain Jones is assigned to the Department of History, U.S. Air Force Academy. Research for this article was supported in part by a grant from the DSMC/USAF Academy Joint Research Group.

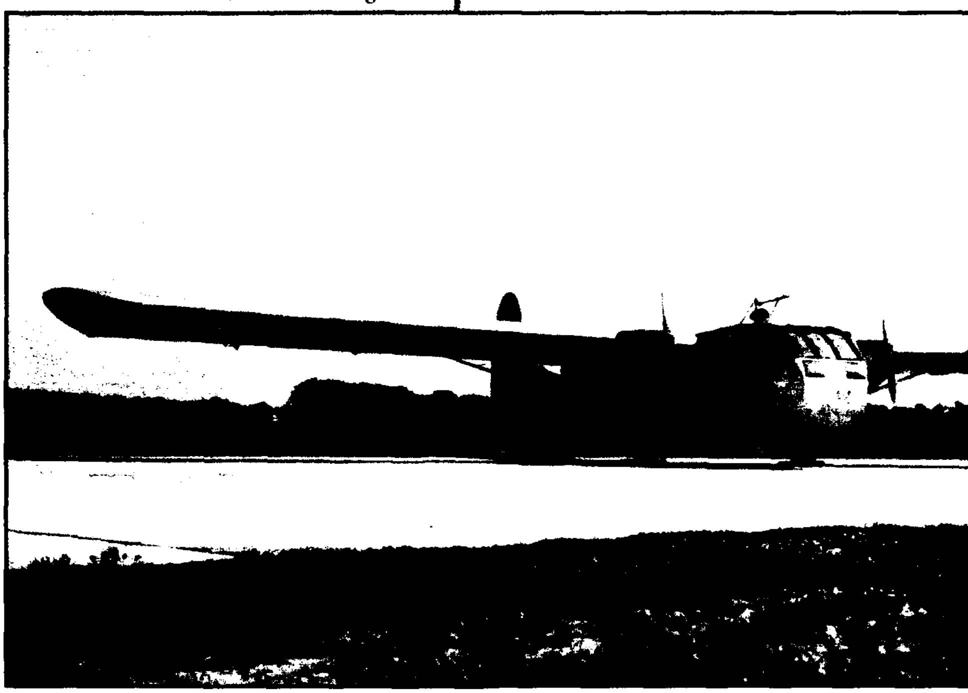
1941-1945

Technological innovation lies at the heart of defense acquisition, and ideas and beliefs about the nature of warfare properly influence acquisition decisions. The development and use of military gliders between 1941 and 1945 illustrate this point.

From their first use in combat during the invasion of Sicily in July 1943 to the end of the war, gliders promised much but delivered little. An analysis of their implementation underscores interaction between the home front



The Northwestern XPG-2A, a CG-4 with engines.



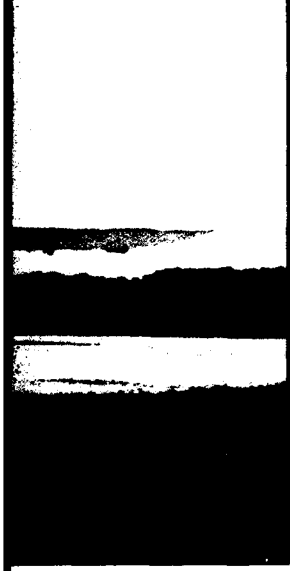
Photos from Special Collections Branch, USAF Academy Library.

and battle front, the military and industry.[1] It focuses on the process of technological innovation and the key role ideology plays in the process. As a military weapon, the glider failed in WW II largely because American airmen adhered to a strategic bombing doctrine for which the glider played no major role.

Innovation/Ideology

At this point, innovation and ideology deserve explanation. A definition of innovation can be straightforward; in the simplest terms, it is anything new to an organization. It does not have to be something original outside the organization — brand-new creations are not necessary for innovation to occur.[2]

The CG-4 glider, nicknamed "Hodrian," carried 15 fully equipped soldiers and a small jeep, accessible through the nose section of the plane.



This is an important point. Military gliders existed in the German and British air forces by 1939. The U.S. Army Air Forces (AAF) had not considered them seriously until 1940. But shortly thereafter, many organizations within the U.S. Army began simultaneous efforts to employ the military glider technology.

Prevailing ideology powerfully influences the hundreds of decisions the innovation process demands. An ideology orients an organization with respect to its past and its vision of the future.[3] This shared definition of the organization and what it will be guides decision making and is reflected in planning and execution of plans. It has obvious implications for innovation, as the American introduction of gliders into combat in Sicily clearly reveals.

The main actors in this story of technological innovation were the Army Air Corps, renamed the AAF on June 20, 1941, and the Waco Aircraft Company of Troy, Ohio. Both had visions of the future which grew from their interwar experiences, and both had set plans reflecting these presumptions.

For the AAF, strategic bombing doctrine served as an ideology and shaped airmen's notions of innovation. Likewise, Company President Clayton J. Brukner communicated his vision for the future and developed plans to ensure viability of his company. These plans set Waco on a path intersecting the AAF road toward mobilization — and independence.

The Ultimate Weapon

The AAF entered the industrial mobilization game late, despite the fact that aviation had captured the imagination of some Army officers and the American public during World War I (WW I). In the minds of some, after the war the expectation grew that planes could serve as the ultimate weapon. As a result of theoretical studies at Maxwell Field, Ala., airmen ultimately claimed that high altitude, daylight and precision bombing of an enemy's economic infrastructure would single-handedly win future wars.[4]

As air leaders of this opinion dominated the AAF, they were able to direct the little money received during the depression toward their vision. Continued technological advances fueled the public's and airmen's enthusiasm for air power. For some, this promised an alternative to the holocaust of WW I.[5] In order to turn these visions into reality, airmen pursued aeronautical innovations which supported their evolving conception of war. The best example of this ideologically focused research was the Boeing B-17 heavy bomber.

According to its most ardent supporters, the B-17 had the range and payload which would, with sufficient numbers, bring an enemy to its knees quickly. With doctrinal and technological issues settled, airmen addressed the neglected problem of industrial mobilization.

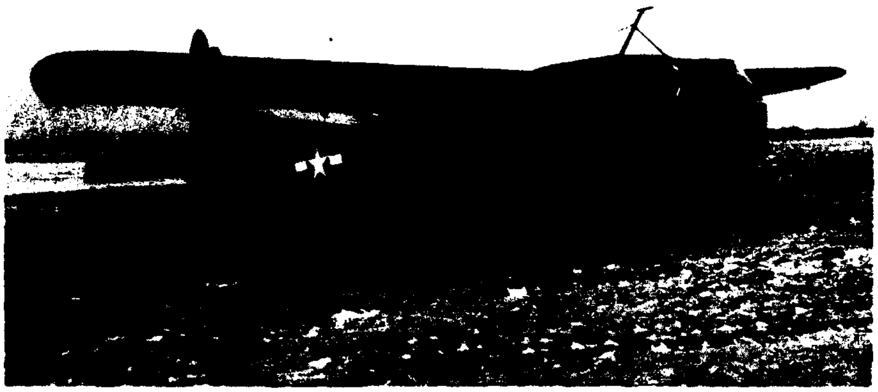
The Strategic Bombing Doctrine

As war approached in the aftermath of the September 1938 Munich Crisis, the biggest problem was to acquire enough B-17s and other heavy bombers to implement the strategic bombing doctrine. This would take all the manufacturing capability of the major aircraft companies and leave them unable to produce anything else. General Henry H. "Hap" Arnold, Commanding General of the AAF, knew he had to find more manufacturing capacity. He pointed out:

> ...some of the airplane companies such as Waco, Ryan, Stinson, Beech Aircraft Corporation, Spartan and possibly oth-

> ers who are now building commercial airplanes have had sufficient airplane manufacturing experience to qualify them for the manufacture, in time of emergency, of the primary training and basic training types....If the burden on the peace time military airplane industry can be lightened in this manner, increased experienced capacity will be available for the emergency requirements in military combat types.[6]

Only two months previously, Brukner volunteered Waco for defense contracting and now was waiting for the orders to arrive.[7] Not surprisingly, Colonel A. W. Robins' more detailed planning premises included elements of this guidance. For example, first on his list of priorities was "[a]ssigning Army types and models to respective current manufacturers."[8] By the summer of 1941, defense contractors were approaching capacity, and Waco's turn was near. When the company won its largest defense contract, the result was the birth of the military glider program.



Recommended changes in the CG-4 resulted in the XCG-15 in 1944, with a wingspan 21 feet less than the CG-4A. It could land on a shorter runway.

Glider Program

Arnold's decision to initiate the glider program derived from developments overseas. The Soviet Union and Germany had experimented with gliders before the outbreak of war in 1939. American airmen knew this but showed no interest in this unique aeronautical capability.[9] In some measure, this was due to their focus on strategic bombing. Gliders, after all, were a tactical weapon and had ties to the Army. Such an auxiliary use of air power detracted from the strategic mission airmen were trying to accomplish. Auxiliary aviation had found a more receptive audience in the German military.

The *Luftwaffe* embraced the idea of marrying air power with ground forces and put the glider to effective use in the Low Countries in 1940 and Crete in 1941. Arnold knew the American air force had no similar capability. Despite the glider's doctrinal incongruity in the AAF, he ordered Wright Field to introduce the innovation as soon as possible. With such high priority and little guidance, the AAF struggled to define what a military glider actually was. The plans to achieve the general's goals were understandably confused.

Thus, the sudden emergence of the glider program in June 1941 required drastic actions. The need for a new kind of pilot meant that the Secretary of War had to countermand a 1932 order prohibiting Army personnel from flying in a glider.[10] Since peacetime military contractors were fully engaged in mobilization, procurement officials had to establish relationships with companies about which they knew little. But, the heightened importance of gliders could not shake the priorities airmen had established through the years, nor did it overturn existing plans.

Constraints on Program

These new ties with business, for example, were to conform to the AAF scheme for mobilization. Constraints on the glider program included no interference with ongoing military contracts, designs which minimized or avoided the use of any materials also employed in the strategic bomber program, and a much lower priority rating for materials that met a need elsewhere in the mobilization program.[11] Less than 12 months after development started, these conditions jeopardized Arnold's desire to field gliders quickly.

As a result, the program got off to a rough start. Intelligence from Europe indicated that the German glider could carry 15 equipped soldiers and a small truck. Wright Field officials used this to guide the companies that offered specific proposals to the military for the glider. With no American experience from which to draw, the German information, though sketchy, was a start.

Attempts to have Soviet documents translated into English offered early evidence that the glider problem would be tough to solve. Intelligence analysts told Wright Field that the Russian translators were too busy with higher-priority projects.[12] The technical requirements for the American military glider evolved slowly as the senior leadership struggled to determine its combat role.

Sixteen Contractors

Initially, the Air Force chose 16 contractors to manufacture CG-4 gliders. Waco produced the design and was primary engineering contractor,and also a major manufacturer of the glider. If Waco had been in the second tier of companies the AAF considered during mobilization, then these companies Waco worked with were even further outside parameters the AAF set for consideration.

Included in this group were newcomers to the aviation business like the Babcock Aircraft and Robertson Aircraft companies. Another new arrival was Ford, as it converted its vast production facilities to the aviation program. Included were more recognizable aviation names, most notably the Cessna Company. Engaged in other aspects of mobilization, Cessna was tagged by AAF as one of the most competent companies in the glider program. But Waco had to deal with other firms new to mass production and defense contracting, the most outstanding example being the Ward Furniture Company. Many of these disparate producers asked for, and were usually granted, Army permission to deviate from the master design when compliance meant a longer delivery schedule.[13] Brukner faced a difficult task in coordinating this diverse collection of producers, and drew empathy of officials at Wright Field. One wrote, "Poor old Waco doesn't do anything else but interview firemen who want to build gliders."[14]

The CG-4 Glider

The CG-4 glider, nicknamed the "Hadrian," saw the most combat action during the war. The nose section opened vertically upward (similar to today's C-5 aircraft), thus allowing rapid on- and off-loading of men and equipment—if the glider landed intact.

Through a series of experiments, the AAF determined that the Douglas C-47 cargo plane made the best tug, towing up to three gliders simultaneously. During the war, other cargo aircraft, bombers and even fighters towed gliders on occasion; but, the C-47s did the bulk of the work. The CG-4 won no contests for beauty or gracefulness, but it could carry 15 fully-equipped soldiers and a light jeep, a significant load of combat power.

Further complicating the difficult manufacturing program was the AAF's continuing ambivalence. The only constant in the program was its urgency. Commanders debated concerning types and quantities of aircraft; they tinkered with the pilot training program to the extent that, even when gliders were ready for the front, the AAF had no pilots to fly them.

Difficult Innovation

Typical of these dealings was a February 1942 meeting among officers from Army organizations with a stake in the glider program. The person from headquarters in Washington said designs were too costly and bulky — gliders should take up less room on the transport ships than presently planned. Moreover, he added that Arnold wanted gliders which withstood only one use; the aircraft should essentially be disposable.

The Wright Field representatives countered that safety requirements called for the current approach and anything less substantial would jeopardize aircrews, passengers and cargo. The Troop Carrier Command, which would actually use the aircraft, was openly hostile to the whole idea and seemed reluctant to get involved.[15] Such confused inputs made technological innovation extremely difficult.

All program problems, while discernible on the home front, were fully realized only on the battlefront. From early May until July 1943, the gliders were poised in North Africa for the impending invasion of Sicily. One observer, Lieutenant Rolland Fetters, traveled through the various echelons in this theater just before the invasion.

Serving as an aide to the Special Assistant to the Secretary of War for Air, Mr. Richard DuPont, Fetters witnessed introduction of this new technology to warfare. His incredibly rich report from this trip revealed the deplorable treatment the glider faced in Africa. It revealed the ultimate consequences this innovation met in the face of an unsupportive ideology.

Levels of Command

Fetters noted different perceptions about gliders at the various command levels. Generals gloated about their units' abilities to field and maintain the new aircraft. The majors and captains at the depot level commented on the lack of parts and tools needed to assemble gliders.

Finally, Fetters met soldiers responsible for actually doing the work and was appalled by the working conditions and products turned out. At one base, he found only eight serviceable gliders out of 28 he inspected, and they needed significant work to be airworthy. Gliders arrived with parts kits missing and in unmarked crates. When the aircraft sections were located, crews found assembly impossible because the Ford fuselage did not match the Waco wings which did not match the Cessna empennage, etc. The gliders themselves demanded that maintainers show initiative, creativity and resourcefulness.

Soldiers instead impressed the lieutenant with their apathy, but he was not surprised given the low priority assigned to their task. All units were undermanned, poorly trained, and underequipped. Fetters wrote that "nothing will improve until we outfit these units and treat the men as we should."[16]

Fetters encountered a reality very different than the picture painted for him at higher headquarters. Those offices, however, were preparing plans for the Allied invasion of Sicily. Those plans reflected the reality air commanders perceived and their prevail-

Over 2000 C-130 Hercules transports have been built, making C-130s the longest production run, more than 35 years, of any military transport.

ing ideology of warfare. Above all, the drive for air force independence influenced air leaders. Even though the effort was to be a joint operation, employing sea, ground and air forces, the airmen stuck to their narrower outlook.

The British Style

The British, partners in this invasion, supplied the overall air commander, Sir Arthur Tedder, who was adamant that the air force remain unfettered by ground and naval planning and operations. Ground and naval commanders, however, reasonably asked to know how much air support to expect over the landing zones. Wing Commander Leslie Scarman, Tedder's personal assistant, said no answer was forthcoming. Scarman wrote, "His attitude then, as always, was 'Tell me what you want done and I will deliver in my own style.'"

Powerfully reinforced by their ally, American flyers continued to place a low priority on gliders. Their overriding concern about independence and the bombing missions in support of the invasion produced a skepticism about operation LADBROKE (the glider assault) and caused foot-dragging and delays in planning air routes for the mission. The airmen's intransigence irked General George S. Patton who asked the naval commander to provide air cover. He fumed, "[y]ou can get your Navy planes to do anything you want, but we can't get the Air Force to do a [expletive deleted] thing!"[17]

Plans called for the British to supply glider pilots while the Americans would pilot the cargo aircraft, the C-47, which served as the tug. The British had used gliders previously in the North African campaign, so many pilots had combat experience. What they lacked was flying time in the CG-4. The rushed but very recent delivery of gliders from the United States to Africa, combined with the logistics problems in the theater, resulted in RAF pilots with only two hours behind the controls of the CG-4 before flying into combat.[18]

A Challenging Task

The AAF C-47 pilots faced the challenging task of towing the gliders from Africa to Sicily at night, getting the aircraft into the proper position to release the glider, then returning home — a 10-hour mission. Of course the Axis powers tried to stop the Allies with antiaircraft artillery, and the weather could further complicate affairs. Pilots carried much anxiety with them on this mission, but they also carried their notions of the gliders' usefulness in combat.

The evening of the planned invasion, July 9, 1943, General Dwight D. Eisenhower agonized about the decision to launch the aircraft in the face of the gale that was blowing in the Mediterranean. Realizing that scrubbing the missions would mean a month's delay until the moon would again cast enough light, Eisenhower gambled that the planes would get through. The rough weather heightened complexity of the pilots' tasks. With so many inexperienced people at the controls, chaos reigned. Tugs got lost and returned to Africa. One released its glider over Malta — half way to Sicily and Eisenhower's command post. Most arrived near Sicily but when the Germans opened fire on the aircraft, many C-47s immediately released their gliders.[19] Those that continued had difficulty finding the drop zone and simply guessed where to release the gliders. All problems of the C-47 aircrews suddenly became the glider crews' dilemmas.

In the darkness, over unfamiliar territory, the glider aircrews had no control over their rate of descent and very little over their landing site. Many, unfortunately, landed in the sea, and the Waco quickly sank up to the wing panels. With no escape hatches built for the airmen and soldiers, hundreds of men lost their lives in the Mediterranean. Those landing on Sicily could do little more than hope for a mild crash. Gliders that smashed into trees and had wings ripped off, but otherwise remained intact, were common. Some ran over rock walls which ruined the aircraft but not the men and equipment inside.

Mission Failed

Others were not so lucky. Some gliders crashed before slowing significantly, and many soldiers never faced the enemy. In short, most of the glider invasion force landed more than five miles from the drop zone. In the bad weather and confusion of combat, the Allies lost or killed most of their own troops.[20] A glider assault on Sicily would have been difficult under ideal conditions. On July 9, 1943, the mission failed.

Cargo assault aircraft C-123 used in the Korean conflict. Shown here is a C-123 on a spraying mission in 1976.

Historians have debated the use of glider and airborne troops during the invasion of Sicily. John Keegan, for example, in his acclaimed *The Second World War*, assesses airborne operations in general, including gliders, in this summation:

> There is a possibility that a combination of luck and judgement will deposit him [the airborne soldier] and his comrades beyond the jaws of danger, enable them to assemble and allow formed airborne units to go forward to battle; but the probability is otherwise.

Surprisingly, and with little evidence, Keegan claims that Sicily and Normandy were the only examples which "evade[d] the probabilities." Carlo D'Este counters Keegan's evaluation of Sicily, but seconds his evaluation of airborne and glider operations. Sicily failed, he argues, because commanders did not take into account the difficult terrain and the relatively untested airborne tactics. He believes they were focused instead on inter-Service rivalries and on planning operations which emphasized the strength of each Service. My thesis holds that gliders offered no comparative advantage to the airmen in this inter-Service struggle, and the difficulties on the home front revealed their ambivalent attitudes toward this new technology. Like D'Este, I think combat operations in Sicily proved the glider failed, and I think Keegan outlines the specific problems airmen failed to overcome. Our opinions and debates can contribute to policy making today, but contemporary assessments seemed clear.

American airmen quickly offered their assessment. One C-47 pilot said he "would rather not have anything to do with these parasites." Another said that his "main objection other than the glider being a pile of junk, was the decrease in flying speed of the tug ship, with the glider in tow." The pilots volunteered to Lieutenant Fetters a solution to the maintenance nightmare the gliders caused: "The hell with the maintenance, we don't want to tow them around anyway."[21]

After many days in Africa and Sicily and many animated conversations with the troops, Fetters concluded the report to his commanding general with the grim observation that "[i]n general, the personnel in the North African Theater have little care or concern for gliders."[22]

The AAF tried to address problems with glider technology in the months after the assault. Specific recommendations for CG-4 improvements ranged from better cockpit instrumentation to escape hatches. In fact, changes became so substantial that, instead of designing a CG-4B (an updated version of the basic model), Wright Field asked Waco to design the CG-15, a much more capable aircraft.[23]

Glider Pilot Training

The glider pilot training program began graduating Americans fully qualified to fly in combat, and production problems diminished. But gliders were far from finding a home in the AAF. General officers regularly called for smaller production quantities or outright cancellation of the program.

Increased battlefield effectiveness failed to squelch the critics. Most indicative of the enduring strength of the Air Force drive for independence was the call at the end of the war for gliders with engines, thus eliminating the need for a tug. All along the glider necessitated cooperation with ground forces which airmen found uncomfortable. This proposal allowed airplanes to be airplanes. The oxymoron — multi-engined glider — was the AAF's most succinct commentary on glider technology.

Many officers and companies, including Waco, worked diligently in 1945 to solve the problem, but top air leaders knew these steps were part of an awkward transition to cargo assault aircraft, like the C-123 of the Korean Conflict and the C-130 of today.[24] Once all parties recognized the absurdity of "powered gliders," cargo gliders and the niche they were intended to fill left military minds until Vietnam. Then, the importance of inserting men and material at the battlefront while maintaining the element of surprise compelled the Army to develop and procure its own air force built around the aeronautical technology of the helicopter.

The glider, an example of failed innovation, revealed how encompassing the technological innovation process was. The introduction of gliders into combat required actions from military officials in Washington, D.C., at Wright Field, in North Africa and Sicily. It touched firms in the aviation industry and impacted civilian agencies which administered the mobilization. In short, it demanded manufacturing, administrative and organizational innovations in the military and in business.

Frustrations

This complexity is familiar to acquisition professionals today. Some may find comfort in learning that our experiences and, perhaps, frustrations are not new. Others may express disappointment that some things never change. In this instance, the program suffered because the logic of this technology and its mission countered prevailing Air Force doctrine.

Ideas matter. Discerning the most important ideas from the crush of issues we deal with in acquisition is difficult. Placing our efforts in an appropriate historical context will help leaders at all levels communicate priorities more clearly and improve chances for successful technological innovation.

Endnotes

1. Many good histories take this kind of broad approach to the study of World War II. See for instance R. J. Overy, *The Air War*, 1938-1945 (New York: Stein and Day, 1981) and Michael S. Sherry, *The Rise of American Air Power* (New Haven: Yale University Press, 1987), both of which are noteworthy for their consideration of the political and economic dimensions of American air power. Studies focusing more on economic issues include Irving B. Holley, Jr., *Buying Aircraft: Materiel Procurement for the Army Air Forces* (Washington, D.C.: GPO, 1964), Harold G. Vatter, *The U. S. Economy in World War II* (New York: Columbia University Press, 1985); and R. Elberton Smith, *The Army and Economic Mobilization* (Washington, D.C.: GPO, 1991, reprint). My study contributes to this literature by examining the effects of the powerful political and economic forces on a particular technology which failed. Most histories have emphasized the successes in the mobilization story.

2. I have borrowed this broad interpretation of innovation from Louis Galambos, "The Innovative Organization: Viewed from the Shoulders of Schumpeter, Chandler, Lazonick, et al.," *Business and Economic History*, Vol. 22, No. 1, Fall 1993, p. 84.

3. Howard G. Jones III, "A New Rival: The Rise of the American Air Force," *Air Power History*, Winter 1991, p. 28.

4. For good treatments of the emergence of strategic bombing see Frank Futrell, *Ideas, Concepts, Doctrine: A History of Basic Thinking in the United States Air Force*, 1907-1964 (Maxwell Air Force Base, Ala.: Air University Press, 1971); Thomas H. Greer, *The Development of Air Doctrine in the Army Air Arm, 1917-1941* (Washington, D.C.: GPO, 1955); and Lee Kennett, *A History of Strategic Bombing* (New York: Scribner's, 1982).

5. Aviation permeated many aspects of American culture. Studies exploring its influence include Sherry, *The Rise of American Air Power*; Joseph J. Corn, *The Winged Gospel: America's Romance with Aviation, 1900-1950* (New York: Oxford University Press, 1983); and William M. Leary, ed., *Aviation's Golden Age: Portraits from the 1920s and 1930s* (Iowa City: University of Iowa Press, 1989).

6. Major General H. H. Arnold to Chief, Materiel Division, January 9, 1939. Air Force Materiel Command Archives, Wright-Patterson AFB, Ohio.

7. Clayton J. Brukner to Major General H. H. Arnold, October 15, 1938. "War Department, 1930-1941," Clayton J. Brukner Papers, Wright State University Archives (WSUA), Dayton, Ohio.

8. Colonel A. W. Robins to Major General H. H. Arnold, January 31, 1939. AFMCA.

9. Paul M. Davis and Amy C. Fenwick, *Development of Gliders in the AAF* (Air Technical Service Command History Office, Study #216, May 1945, pp. 3-5.

10. Memorandum, Secretary of War, June 5, 1941. "Correspondence, 1941-1947," William C. Lazarus Papers, U.S. Air Force Academy Library Special Collections (USAFA Spec. Col.), Colorado Springs, Colo.

11. Interoffice Memorandum, February 7, 1942. "Correspondence, 1941-1947," Lazarus Papers, USAFA Spec. Col.

12. Memorandum, August 25, 1941. "Correspondence, 1941-1947," Lazarus Papers, USAFA Spec. Col.

13. Davis and Fenwick, p. 197.

14. Colonel F. O. Carroll quoted in *ibid.*, p. 107.

15. Meeting Minutes, February 16, 1942. "Correspondence, 1941-1947," Lazarus Papers, USAFA Spec. Col.

16. First Lieutenant Rolland F. Fetters, "Overseas Assignment for the Investigation of Army Air Forces Glider Program in European Theater of Operations," AFMCA.

17. Carlo D'Este, *Bitter Victory: The Battle for Sicily, 1943* (New York: E. P. Dutton, 1988), pp. 167-9.

18. For accounts of the planning efforts and the assault on Sicily, I relied on D'Este, *Bitter Victory*; William R. Breuer, *Drop Zone Sicily: Allied Airborne Strike, July 1943* (Novato, Calif.: Presidio Press, 1983); and Wesley F. Craven and James L. Cate, *The Army Air Forces in World War II*, Vol. 2. *Europe: Torch to Pointblank, August 1942 to December 1943* (Washington, D.C.: GPO, 1983).

19. Breuer, p. 42.

20. *Ibid.*, p. 45; D'Este, pp.231-2.

21. Fetters, "Overseas Assignment," *Daily Diary*, July 11, 1943, AFMCA, p. 11.

22. *Ibid*, Report to Commanding General, Headquarters Air Service Command, AFMCA, p. 3.

23. Davis and Fenwick, p. 176.

24. Raymond J. Snodgrass, *The AAF Glider Program, November 1944 to January 1947* (Air Materiel Command History Office, Intelligence Department, Study #217, 1947) pp. 54-5.

SEND US YOUR ARTICLES FOR PROGRAM MANAGER

Journal of the Defense Systems Management College

The editors of *Program Manager*, DSMC's bimonthly journal, are interested in your thoughts on policies, processes, trends, and events in the areas of program management and defense acquisition. We invite you to submit articles and share your experiences. We are interested in lessons you have learned through your acquisition experiences, successful and otherwise.

Beyond the demand for good grammar, we have some tips for prospective authors. Consistency and uniformity are essential. The renowned stylist William Strunk, Jr., said, "If those who have studied the art of writing are in accord on any one point, it is this: the surest way to arouse and hold the attention of the reader is by being specific, definite and concrete."

Style

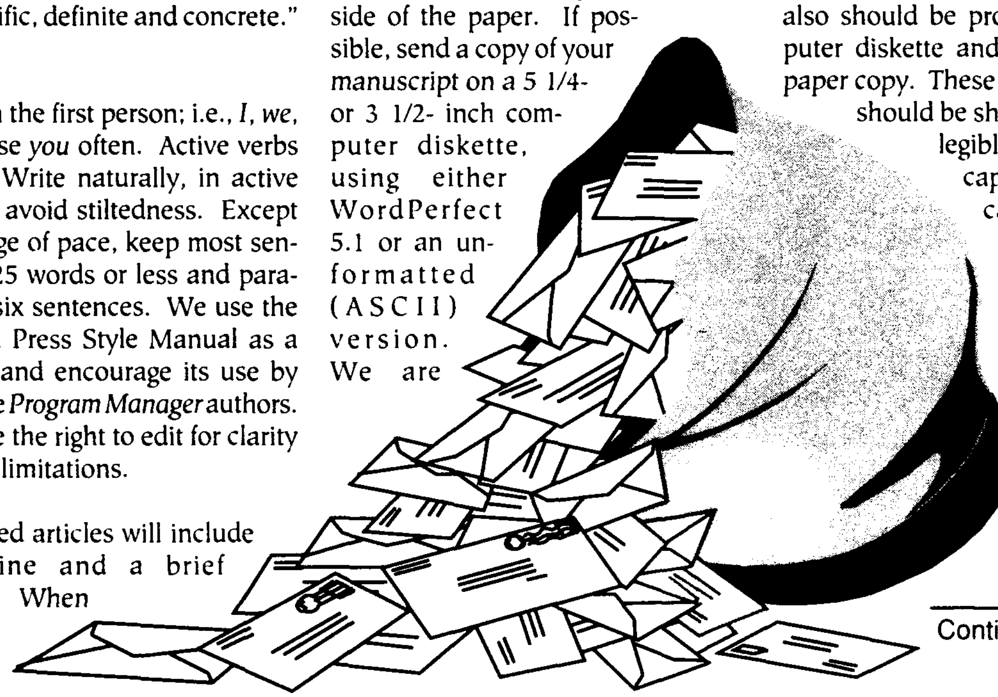
Write in the first person; i.e., *I*, *we*, *our*; and use *you* often. Active verbs are best. Write naturally, in active voice, and avoid stiltedness. Except for a change of pace, keep most sentences to 25 words or less and paragraphs to six sentences. We use the Associated Press Style Manual as a reference, and encourage its use by prospective *Program Manager* authors. We reserve the right to edit for clarity and space limitations.

Published articles will include your byline and a brief biography. When there are substantial editorial changes, the DSMC Press staff clears edited copy with the author.

If possible, clear articles through your public affairs office or an equivalent authority. Most of the articles we publish are reviewed routinely and cleared by the Director, Security Review, Office of the Assistant Secretary of Defense for Public Affairs. When necessary, articles are reviewed by DSMC faculty members with expertise in the subject matter. The receipt of your manuscript will be acknowledged within five working days.

Length and Graphics

The Basics: We prefer to receive a paper copy of your manuscript, doubled-spaced and printed on one side of the paper. If possible, send a copy of your manuscript on a 5 1/4- or 3 1/2- inch computer diskette, using either WordPerfect 5.1 or an unformatted (ASCII) version. We are flexible regarding length, but we prefer 2,000-3,000 words—about 10 doubled-spaced pages each having a 1-inch border on all sides. Don't feel constrained by length requirements; make your statement in the most direct way, regardless of length.



We use figures, charts and photographs. Color is acceptable, but we prefer glossy, black-and-white photographs measuring 5 by 7 or 8 by 10 inches. We cannot guarantee the return of photographs. Include brief, numbered cutlines keyed to the photographs. Place a corresponding number on the lower left corner, reverse side of the photographs. With this exception, do not write on photographs. Photocopies of photographs are not acceptable. Charts and figures also should be provided on a computer diskette and in addition to a paper copy. These charts and figures should be sharp and clear with legible information and captions. We prefer camera-ready art, but the DSMC Visual Arts and Printing and Duplicating Services Division can work with sketches if they are clear and precise. Authors are responsible for

Continued on page 35

COUNTERPOINT

DEPARTMENT OF THE NAVY STRATEGIC SYSTEMS PROGRAMS OFFICE

A Premier Program Management Institution

Ibrahim A. Ashie

My purpose in writing this article is to discuss some issues raised by "The Metamorphosis of Program Management, Rainbow of Change," by Colonel W. E. Cole, USAF. It appeared in the May-June 1993 *Program Manager.* Also, I explain briefly the functions of the Department of the Navy's first program management office, relative to the so-called new management paradigm of Total Quality Management (TQM).

The Japanese did not devise the new management concept. The concept and its components have been described in Department Of Defense (DOD) directives, instructions, military specifications, standards, documents and pamphlets since the end of World War II.

U.S. Business after World War II

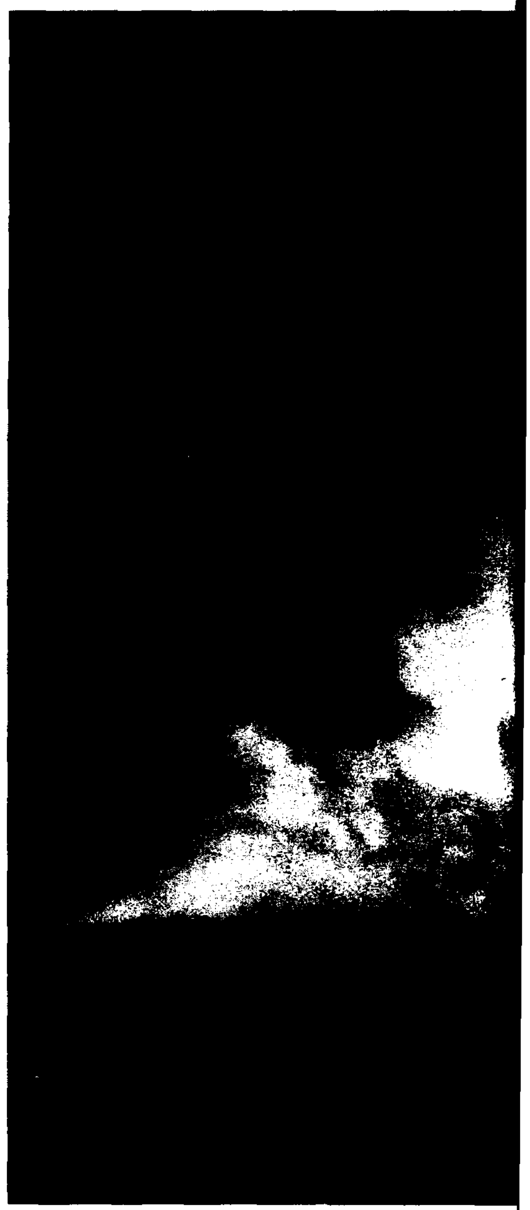
The U.S. business community did not use these managerial tools developed by DOD immediately after the war because there was a vast domestic market ready to consume whatever it manufactured. Furthermore, the economic environment of the country was characterized by a need for capital formation dictated by the financial market (Wall Street), with stockholders' lust for instant reward.

These conditions led companies to employ chief executive officers (CEOs) who could bring the most end-of-the-year profits to the company, since companies' performances were evaluated by the bottom line of their quarterly and annual financial reports. Long-range planning was uncommon since most of these CEOs were concerned only with short-range results. The concept of efficient and effective use of resources was not a consideration as long as profits kept coming in.

U.S. Air Force Adoption Of the New Management Concept

Contrary to Colonel Cole's statement that the Air Force Materiel Command is developing a twin to this new management approach, which is named the Integrated Product Development (IPD), the concept had already been published in the form of MILSTD-499 (USAF) 17 July 1969 (Engineering Management). This Standard had all the building blocks or the ingredients of the so-called TQM.

In their textbook, *Managing (A Contemporary Introduction)*, Joseph L. Massie and John Douglas pointed out that a manager must constantly develop the vision and the wisdom for



Trident II (D5).

Mr. Ashie is a System Engineer, Plans, Programs and Training Branch, Strategic Systems Programs, Department of the Navy.

putting the building blocks of management into a meaningful whole. They identified these building blocks to be:

1. Theory and Practice
2. Operations and Activities
3. Types of Knowledge
4. Functions and Processes
5. Skills and Interests.

Since most DOD program managers were specialists rather than generalists, they were not able to utilize full potentials of MILSTD-499, or to use them effectively.

Formation of First Program Office

On January 7, 1957, an organization then called the Special Project Office (SPO) within the Department of the Navy was established to manage the underwater launching of ballistic missiles. The functional subsystems of the new weapon system were established to delineate clearly interfaces that also defined the SPO organizational structure and which remain to this day. Figure 1, reproduced from the *History of the FBM System* by Lockheed Missile and Space Company Inc., shows the SPO structure.

The current name of the organization is the Strategic Systems Programs (SSP) command. When program management became popular in the early 1970s, the Navy designated this agency as Program Management Office No. 1 (PM-1).

Subsequently, the Navy performed a study on occupational information, resulting in a guide entitled *Project Management Positions in the Department of the Navy*, October 1981. It was modeled after the SSP organizational structure.

A brief discussion of the SSP functions, relative to issues raised by Colonel Cole, follows:

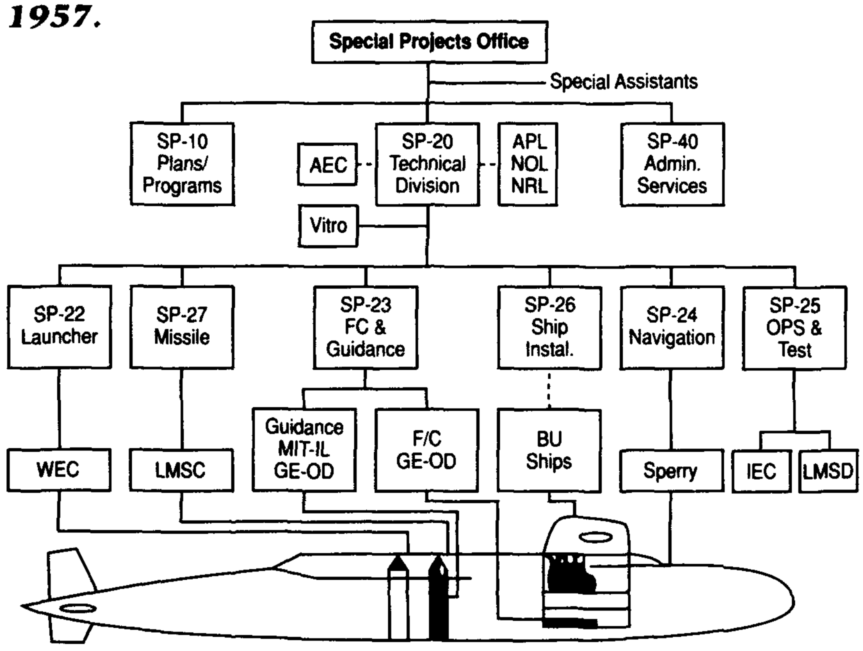
1. *Product and Process-oriented Organization/Integrated Product Development.* As seen in Figure 1, SSP's formation had this purpose in mind.

2. *Teams.* Each functional branch of SSP (for example SP-27 the Missile Branch) comprised a team of engineers, program analysts, logisticians, budget analysts and uniformed Navy personnel experienced in operations of the Fleet Ballistic Missile (FBM) submarines. The original team of the organization was credited with development of the Program Evaluation and Review Technique (PERT) which is used widely in program management.

This tool was modified by the National Aeronautical and Space Administration (NASA) and called NASPERT. It was used in the system acquisition and management of the space program in its early years.

3. *Customer Needs.* Throughout development of the FBM system,

FIGURE 1. Special Projects Office Organization — 1957.



(NOTE: MIT-IL = Instrumentation Laboratory of MIT; now called the Draper Laboratory.)

operational Navy personnel (ultimate users of the system) have been active participants.

They were and are consulted at every stage of program development and in the design and placing of equipment in both the submarines and at the training facilities.

4. *Empowerment/Pride in Ownership*. Principal engineers and their teams are responsible for developing budgets in response to program directives and requirements. The team initially presents the budget to the branch management for internal review and corrections.

The same team then presents the budget to the command's Board Of Directors (BODs), and answers BOD questions. Upon budget approval, the team with the help of the branch budget analysts initiates Procurement Request (PR) for the acquisition of its subsystem. Then, the team works with contracting and legal personnel to compose the Request For Proposal. The team evaluates the technical portion of the proposal, performs fact-finding with the winning contractor, and participates in contract negotiations.

After contract award, the team starts monitoring the contract for conformance to cost, schedule and performance (CSP) requirements, with the help of command plant technical representatives and Defense Logistic Agency personnel.

The pride of program ownership is enhanced by encouraging every SSP staff member to visit the FBM training facilities or observe missile firing at Cape Canaveral, Fla., or participate in submarine demonstration and shakedown operations (DASO), or visit a submarine in port.

5. *In-process Quality Control/Statistical Quality Control*. Quality control is performed at every stage of each subsystem development cycle. There are weapons specifications to be met for each critical item and for each subsystem. Statistical quality control is used, where necessary, to satisfy tolerance requirements during manufacture of components.

6. *Continued Process/Product Improvement*. In Figure 1 of the SSP organization, you can see the major team has two notable university units as members: the Draper Laboratory of the Massachusetts Institute of Technology and the Applied Physics Laboratory of the Johns Hopkins University.

These laboratories, the Atomic Energy Commission (now part of the Department of Energy) and Navy laboratories work together to improve continuously the FBM system with state-of-the-art technology. The training facility and the fleet personnel provide suggestions for system improvement. These personnel generate trouble and failure reports (TFRs) for hardware, software and documentation for the purpose of system improvement. These improvements have helped develop the weapons system from the original POLARIS through POSEIDON to the present TRIDENT II system.

7. *Collocation*. The staff of SSP is centrally located, which facilitates face-to-face communication and instantaneous exchange of ideas among lawyers, engineers, financial resource analysts, program analysts and contracting personnel. This collocation provides a cohesive and tolerant team atmosphere.

Conclusion

From the above discussions, it can be concluded that TQM and its other names were not of Japanese origin, but have been in existence since 1957. They have been part of the operating procedures of the Department of the Navy Strategic Systems Programs command.

National and military security has shielded this command from the business world.

Now that the Cold War is ended, the Defense Systems Management College should consider using this command as a program management model and encourage DOD components to use this command as an internship institution for prospective program managers.

References

1.Massie, Joseph L. and Douglas, John, *Managing (A Contemporary Introduction)*, 4th Edition, Prentice-Hall Inc., Englewood Cliff, N.J., 1985.

2.Lockheed Missile and Space Company, Inc., *History of the FBM System*, 1989.

USS Tennessee (SSBN 734).

Continued from page 31

submitting photos and other illustrations pertinent to their manuscripts.

Attribute all references you have used in researching your article. Use separate footnotes, identified at the appropriate place in the copy.

Be wary of using copyrighted material. It is generally felt that Section 107 of Title 17, United States Code, "Limitations on Exclusive Rights: Fair Use," clears the way for quoting short passages of copyrighted material in a scholarly or technical article to illustrate or clarify the author's observations. It also permits summarizing copyrighted addresses and articles with brief quotations. Lengthy use of copyrighted material requires written permission from the copyright holder. Likewise, if you are the copyright holder, your cover letter should explicitly state that the Defense Systems Management College has permission to publish your material in *Program Manager.*

Stories that appeal to our readers, who are senior military personnel and civilians in the program management/acquisition business, are those taken from *your own* experience rather than pages of "researched information."

Again, be sure to double-space your copy and use only one side of the paper. We appreciate your readership, and interest in *Program Manager.*

If you need to talk to an editor, please call:

Esther M. Farria or Robert W. Ball at (703) 805-2892/3056; DSN 655-2892/3056: or send a letter addressed to:

DEFENSE SYST MGMT COLG
ATTN DSMC PRESS
9820 BELVOIR ROAD
SUITE G38
FT BELVOIR VA 22060-5565.

ON-LINE, TECHNOLOGY-BASED

DOD ACQUISITION HISTORICAL CENTER BEGINS SYSTEM DEVELOPMENT PHASE

Officially Open for Business in Spring 1994

The effort to establish the Department of Defense (DOD) Acquisition Historical Center at the Defense Systems Management College (DSMC), a project begun in 1992 by the Under Secretary of Defense (Acquisition), has recently completed the concept exploration phase and entered the demonstration and validation phase for system development.

The DSMC Commandant, Brig Gen (Sel.) Claude M. Bolton, Jr., USAF, approved the project's acquisition strategy and system selection, and directed development of the electronic finding aids database prototype.

Already collecting acquisition information and open to researchers on a case basis, the Center — also referred to as the "acquisition archives" — will open officially in the spring of 1994 on a part-time basis using interim manual procedures. Once open, the Center will add a new dimension to the research capability of DOD personnel. Plans call for the Center to be fully operational by mid-FY 1997, contingent upon available funding.

The USD(A) established the Center at DSMC to meet the need for a central DOD repository for defense acquisition information. The Center's mission is to accomplish that goal and become an electronic forum within DOD for collecting, storing and retrieving historical acquisition information, and to support the overall DSMC mission of improving management of the acquisition process.

Optical Disk Technology Reduces Storage Requirements

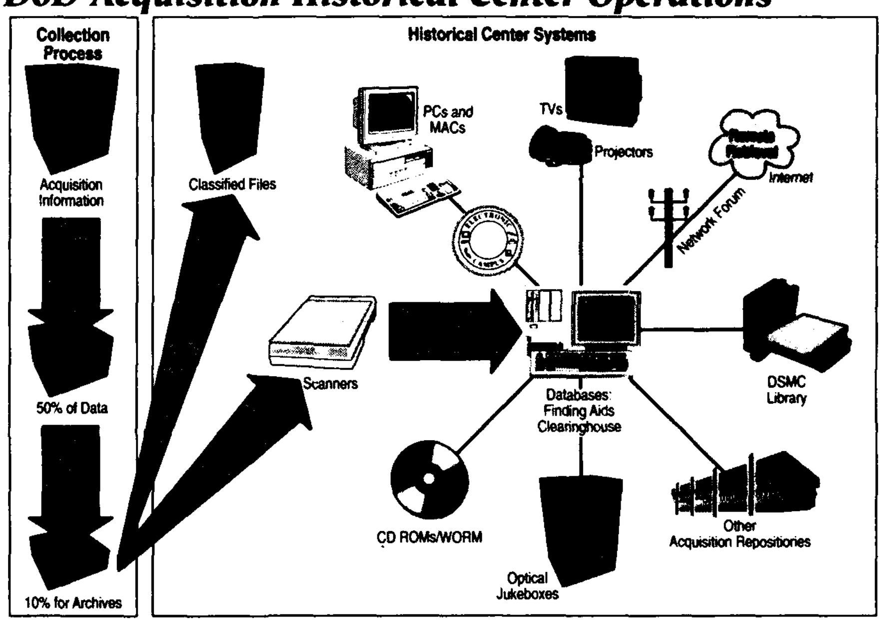
The Center's system will incorporate state-of-the-art imaging and optical disk technology to reduce storage requirements and provide expeditious, user-friendly workstation on-line search service. Remote access will be provided via the Defense Data Network and Internet or a modem connection. The system will allow access to the DSMC library database through DSMC's electronic campus project. Ultimately, the Center plans to compile a clearinghouse finding aids database of acquisition information held in government and nongovernment repositories.

Potential users include acquisition managers, students of the Defense Acquisition University consortium members, and other researchers from DOD, other government organizations, industry, academe and the public. Potential donors include the Office of the Secretary of Defense, Military Services and other DOD organizations, government and industry acquisition activities, academe and individuals.

Collects Donated Copies of Nonsensitive Information

Copies, not originals, of classified and unclassified information are collected in all media. Donations are voluntary. Donors from DOD are expected to adhere to applicable statutes and regulations of DOD and the National Archives regarding records disposal procedures. Unclassified information donated is considered to be nonsensitive and "publicly releasable," or to meet one of the nine exemptions under the Freedom of Infor-

DoD Acquisition Historical Center Operations



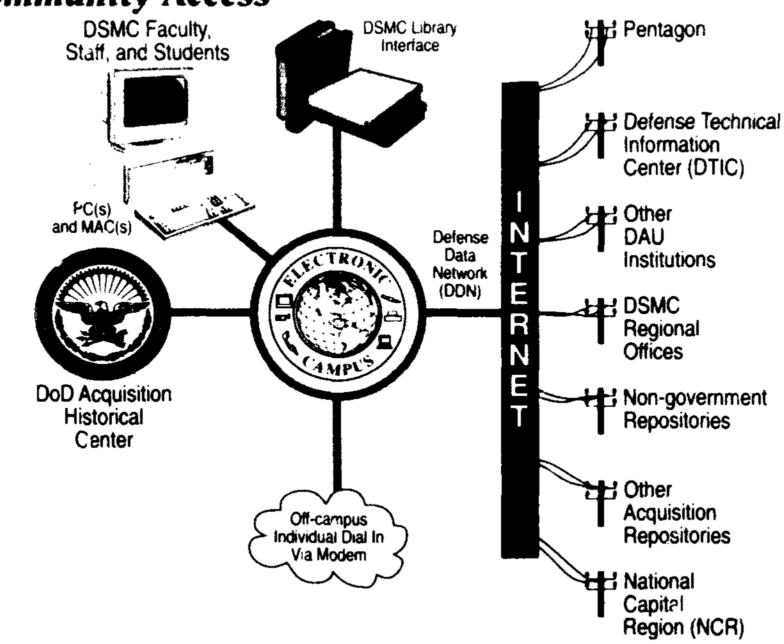
mation Act. The Center does not collect material containing proprietary data, top secret or nuclear weapons material, commercially printed material, information deemed sensitive to the originator or donor, or duplicate information collected by other DOD activities such as the Defense Technical Information Center.

Items being collected include:

—Program management office records
—Lessons learned
—Decision memoranda and policy directives
—Briefing and issue papers
—Case studies
—Personal papers relating to acquisition
—Oral or written histories
—Research papers
—Technical or policy studies and reports
—Government handbooks and guides
—Contract and budget documents
—Industry contractor records
—Congressional hearing reports.

For example, the Center has collected records of the Defense Management Review (former Defense Secretary Dick Cheney's "DMR"); various records of the Defense Systems Acquisition Review Council (predecessor to the present Defense Acquisition Board); various records of the F/A-18 program office; lessons learned from the Multiple Subscriber Equipment program; histories of the Air Force Operational Test and Evaluation Center; various records of the Office of Acquisition Policy and Program Integration; and symposia proceedings.

DoD Acquisition Historical Center Acquisition Community Access



When the full storage and retrieval capabilities are operational, by mid-FY 1996, much of the unclassified information will be available through full-text retrieval allowing workstation printing. Classified information will be available on-site through prior arrangement.

Center Director and Contractor Team in Place

The Center Director is Wilbur D. Jones, Jr., DSMC's Associate Dean of Information. He is assisted by Jane Cohen, DSMC reference librarian. The Center has contracted with the team of Arist Corporation, of Alexandria, Va., and History Associates, Inc., of Rockville, Md., to continue the system development and operate the Center.

Readers can obtain the Center's collection and user policies by writing to:

DEFENSE SYST MGMT COLG
ATTN DIR ACQ HIST CTR
9820 BELVOIR ROAD
SUITE G38
FT BELVOIR VA 22060-5565

Organizations or individuals wishing to donate information can write or telephone Mr. Jones at (commercial) 703-805-2525 or (DSN) 655-2525, or Ms. Cohen at 703-805-2293 or 655-2293.

Photo by Sgt. Richard Vigue, USA

DSMC library reference librarians Maryellen Tipper and Jane Cohen check index of material held by Historical Center

DSMC HOSTS ACQUISITION RESEARCH FORUM

Joan L. Sable

On Tuesday evening, November 2, 1993, the Defense Systems Management College (DSMC) hosted an Acquisition Research Forum with The Honorable John M. Deutch, Under Secretary of Defense (Acquisition and Technology) and other Department of Defense (DOD) officials attending. The Forum theme was "Relevancy of Acquisition Research to DOD's Unfolding Acquisition Challenges."

The 100 faculty and staff attending, a number from the Industrial College of the Armed Forces and Army Management Staff College, included: Dr. Deutch; Dr. James S. McMichael, Director of Acquisition Education, Training and Career Development Policy; Brigadier General (Sel.) Claude M. Bolton, Jr., USAF, DSMC Commandant; Mr. Gerald E. Keightley, Executive Director of the Defense Acquisition University (DAU); Dr. Walter B. LaBerge, DSMC Visiting Professor; and Dr. Benjamin C. Rush, DSMC Dean of Faculty.

The Forum opened with light refreshments and DSMC interactive exhibits and displays. Subsequently, during an award ceremony, two DSMC personnel, Thomas Dolan, Jr., and Donald M. Freedman, received Department of the Army Meritorious Civilian Service Awards for their work on the Department of Defense Advisory Panel on Streamlining and Codifying Acquisition Law.

Brig Gen (Sel.) Claude M. Bolton, Jr., DSMC Commandant and The Honorable John M. Deutch, Under Secretary of Defense (Acquisition and Technology).

General (Sel.) Bolton began the Forum by stating: "DSMC remains at the forefront of knowledge in defense acquisition management education through long-term inquiry into topics of potential importance in improving DOD systems acquisition management. Products of research include classroom experiences, studies for DOD executives, and information in publications for the acquisition management community."

The Research, Consulting and Information Division (RCID) manages the overall program of applied acquisition research at the College. Research is conducted primarily by faculty members and selected students and, occasionally, with outside professionals in cooperative major emphasis including finding ways to reduce and control system acquisition costs more effectively. Current RCID endeavors include the following:

— The Acquisition Research Symposium is a series of conferences that began in 1972 and is conducted biennially. These symposia offer a dynamic forum for dialogue among key professionals working on vital issues facing the acquisition community. The most recent symposium was held in June 1993. Planning has begun for the 1995 symposium.

Ms. Sable, Research Associate of the Research, Consulting and Information Division, DSMC, organized the Forum program.

— The Military Research Fellowship Program, chartered by the Under Secretary of Defense (Acquisition) in 1987 to enhance DSMC capabilities, provides professional military education and develops new and innovative concepts for systems acquisition management. This joint fellowship program is a unique opportunity for selected officers to supplement DSMC research goals and to impact the defense acquisition process. The 1993-94 fellows are working on a handbook for program managers on modeling and simulation. Projected availability of this handbook is September 1994.

— The Senate Armed Services Subcommittee on Defense Technology, Acquisition and Industrial Base has asked DSMC to conduct research in "defense conversion" and "dual-use technologies." The research should address specifically definitions, benchmarks and metrics, goals, milestones, and timetables. The RCID is conducting a preliminary structured study using past and current data to suggest a standardization of these critical terms, to answer the questions posed by the subcommittee and provide recommendations for legislation, if needed.

— Through a unique system called Research on Ongoing Acquisition Research (ROAR), DSMC is beginning to reform how acquisition policy research products are developed and acquired by the DOD. The ROAR monitors more than 1,000 ongoing, acquisition-related study projects across the DOD and in universities. The DSMC uses ROAR information to tell policy makers and researchers who embark on new projects about any current studies that tie into the projects. This allows the newcomer to collaborate, saving the DOD months of valuable time and effort. Other databases and on-line services cannot do what ROAR does — find shortcuts to research solutions for unfolding policy problems.

— The DOD Acquisition Historical Center represents significant potential as part of the DSMC and DAU research capability. The Center, established at the request of the USD(A) in 1992, fills a void as the only central repository of defense acquisition information in DOD. (See the related article in this issue.)

As the Forum continued, Dr. Rush identified processes and projects to enhance and ensure faculty currency in acquisition research. Dr. LaBerge then discussed student electives and how they can produce the most up-to-date initiatives in the acquisition field.

Mr. Keightley remarked on DAU accomplishments since it became operational one year ago and the role of DSMC Press as publisher of the new *Acquisition Review Quarterly*. He also addressed other planned assignments — one being definition of a role for DAU in acquisition research.

The Forum ended with questions and answers between Mr. Deutch, members of the roundtable, and the audience.

STATEMENT REQUIRED BY THE ACT OF AUGUST 12, 1970, SECTION 3685, TITLE 39, UNITED STATES CODE, SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF

Program Manager, published bimonthly at the Defense Systems Management College, Fort Belvoir VA 22060-5565. Number of issues published annually: 6. The Director of the DSMC Press is Wilbur D. Jones, Jr., DEFENSE SYST MGMT COLG, ATTN DSMC PRESS, 9820 BELVOIR ROAD, SUITE G38, FT BELVOIR VA 22060-5565. The Managing Editor is Esther M. Farria, DEFENSE SYST MGMT COLG, ATTN DSMC PRESS, 9820 BELVOIR ROAD, SUITE G38, FT BELVOIR VA 22060-5565. The Publisher is the Defense Systems Management College, Fort Belvoir VA 22060-5565.

The average number of copies each issue during the preceding 12 months:
A. Total number of copies printed (net press run): 9,833
B. Paid and/or requested circulation: 1,316
1. Sales through dealers and carriers, street vendors, and counter sales: None
2. Mail subscriptions paid and/or requested: 7,000
C. Total paid and/or requested circulation: 8,316
D. Free distribution by mail, carrier, or other means, samples, complimentary, and other free copies: 1,500
E. Total distribution: 9,816
F. Copies not distributed
1. Office use, leftover, unaccounted, spoiled after printing: 17
2. Returns from news agents: None
G. Total distribution: 9,833

The actual number copies of single issue published nearest to filing date:
A. Total number of copies printed (net press run): 15,000
B. Paid and/or requested circulation: 1,316
1. Sales through dealers and carriers, street vendors, and counter sales: None
2. Mail subscriptions paid and/or requested: 12,100
C. Total paid and/or requested circulation: 13,416
D. Free distribution by mail, carrier, or other means, samples, complimentary, and other free copies: 1,500
E. Total distribution: 14,916
F. Copies not distributed
1. Office use, leftover, unaccounted, spoiled after printing: 84
2. Returns from news agents: None
G. Total distribution: 15,000

TILTING AT THE WINDMILL OF DEFENSE ACQUISITION REFORM

Lyn Dellinger

"I'm committed to restructuring the acquisition system for a different environment, but to succeed I need your help." This was the message of Dr. William J. Perry, Deputy Secretary of Defense, to graduating PMC class 93-2, at graduation ceremonies on December 10, 1993.

In a keynote address that highlighted changes in world conditions, Dr. Perry congratulated the class on its accomplishments. He stated that the goal of all their hard work was to make them better managers to work in the Defense Department's acquisition system, that the training DSMC had given them was as good as any in the world, but that they were going to need all the knowledge gained to help them manage a transition to a new post-Cold War acquisition system. Dr. Perry referred to a recent best-selling book which had proclaimed the "end of history," and said, "Headlines show that history is still being written in places like Pyongyang, Mogadishu, or Sarajevo. These headlines remind us that we still face difficult and complex problems and that we will need to maintain the technological edge which we demonstrated in Desert Storm if we get in another military conflict in the near future."

On January 24, 1994, the President announced his intention to nominate Dr. William J. Perry to succeed Les Aspin as Secretary of Defense.

But while that necessity remains, Dr. Perry projects a reduction in the defense procurement budget by 1997 of about 60-65 percent of its peak in the 1980s. He said the challenge is to "find a way of maintaining the industrial base which gave us the technological advantage....We have to do this at a reduced cost, and therefore, we have to find more efficient ways of doing it."

Quoting Professor Theodore Leavitt, who said, "Most managers manage for yesterday's conditions because yesterday is where they got their experiences and had their successes," Dr. Perry added that "management is about tomorrow, not yesterday." Consequently, he is proposing a radical revamping of the Department of Defense acquisition system. He said, "...we must take dramatic action to integrate the defense industrial base with the commercial industrial base so that we create a single national industrial base — a single national technology base." He pointed out that the existing system, which evolved over the past five decades, separates the defense base from the national base through unique contracting processes, unique process and product specifications and standards, and unique security procedures. "My objective," he pledged, "will be to have the Defense Department evolve to a

Ms. Dellinger is a Professor of Systems Acquisition Management in the Research, Consulting and Information Division, DSMC. The editor thanks Ms. Janice Baker, DSMC, for her assistance on this article.

fundamentally new acquisition system based on commercial practices."

To accomplish his goals, Congress must provide legislative relief from regulations that have created many of the obstacles to reform of the acquisition system. But, there is support in the Congress. In 1994, the House and the Senate will debate bills that would make substantial changes in defense acquisition practices, to include allowing commercial procurement practices for procuring commercial products, raising the threshold to $100,000 under which DOD could use simplified procurement procedures, and simplifying reporting requirements for operational testing. In Dr. Perry's view, these are important steps, but are still short of what he deems necessary. He wants to broaden the definition of commercial products, exempt commercial products automatically from cost and pricing requirements, and reduce even further the number of unique requirements the government specifies for items it purchases.

> **I have mounted my steed, I have my lance under my arm, and I'm galloping ahead full speed toward that windmill.**
>
> **Dr. William J. Perry**

Aside from what the Congress must do to assist in acquisition reform, there are several things DOD can do, where legislation permits. To uncover these areas, DOD has created the office of Deputy Under Secretary of Defense (Acquisition Reform), headed by Mrs. Colleen A. Preston, to work with teams within DOD. As an example of this effort, Dr. Perry mentioned the search for feasible alternatives to MILSPECS on defense systems, concentrating on near-term, high-payoff changes — a search which has already resulted in a new electronic procurement notice and payment system.

Dr. Perry admitted the task that lies ahead is daunting, and skeptics question whether DOD can break its old bad habits. To scoffers, Dr. Perry quoted Winston Churchill, who told an aide who complained of the exasperating ways Americans have of doing things, "Americans will always do the right thing after having first exhausted all other alternatives."

Dr. Perry concluded by confiding that he had been told often that he should stop tilting at the windmill of acquisition reform. "But," he said, "I have mounted my steed, I have my lance under my arm, and I'm galloping ahead full speed toward that windmill. I ask you to join me in that quest to break down the costly barriers in our system and create a new acquisition system to provide the finest equipment for our forces at a cost the nation can afford."

Photo by Richard Mattox

Brig Gen (Sel.) Claude M. Bolton, Jr., USAF, DSMC Commandant, with Dr. William J. Perry, Deputy Secretary of Defense.

DEFENSE ACQUISITION REFORM

SYMPOSIUM

APRIL 26, 1994

Fort Lesley J. McNair, Washington, D.C.

Hosted by

The National Defense University, The Defense Acquisition University, The Industrial College of the Armed Forces (ICAF), and The John M. Olin Institute for Strategic Studies, Harvard University

Sponsored by

American Defense Preparedness Association (ADPA) Association of the Industrial College of the Armed Forces

This symposium is a follow-on to the 1993 ICAF Symposium "Government, Industry, and Academia: Partnership for a Competitive America." There was a consensus among the panelists at that symposium that these three sectors of our society will find a way to work together to ensure a competitive America. One of the essential areas of cooperation is the acquisition process. As we shift to a new era of fewer resources, it is necessary that the acquisition process be more efficient and effective. The process of the reform of the system must be a cooperative enterprise in which government and industry work together in a true partnership. The April 26, 1994, symposium will provide a forum for representatives from those sectors to engage in open and candid dialogue about a strategy for genuine acquisition reform.

Registration information will be available in the February-March time frame. To be put on the mailing list, contact:

ADPA
Attn: Ms. Mary Murphy
2102 Wilson Boulevard, Suite 400
Arlington, VA 22201
(703) 247-2582

BOOK REVIEW

BEYOND SPINOFF
Military and Commercial Technologies in the Changing World

Harvard Business School Press

by John A. Alic, Lewis M. Branscomb, Harvey Brooks, Ashton B. Carter and Gerald L. Epstein

The authors are associated with the Science, Technology and Public Policy Program (STPP) at the Center for Science and International Affairs, John F. Kennedy School of Government, Harvard University. They have significant government, policy, technology and academic experience. Their treatment of the subject of dual-use; i.e., utilization of defense technology for commercial applications, presents a timely and detailed discussion of issues and policy considerations. Technology transfer from government to civil spin-off, as well as civil to government "spin-on" are addressed.

Many think the present shrinking industrial base offers little opportunity for exploitation of commercial markets. How many nuclear submarines can you sell to the commercial sector? The authors do not suggest that this type of dual-use or spin-off will happen. They do not paint a picture that the next few years will be easy for defense firms. They do, however, point out that many defense technologies can be transferred successfully to commercial applications. They cite manufacturing technologies (numerical control machining, CAD/CAM, composites, etc.) as being prime candidates for spin-off to commercial applications.

Microelectronics and software examples for spin-off and spin-on receive a lengthy examination. The Very High Speed Integrated Circuit (VHSIC) was an Office of the Secretary of Defense (OSD) research and development (R&D) effort to foster technology transfer from commercial and defense companies to defense applications. From a technology standpoint; e.g., image size, some considered VHSIC a limited success. However, technology transfer goals of the program were elusive.

The program was managed by OSD with the intent that the Services would use the VHSIC chips in their programs. The Army, Navy and Air Force weren't convinced the chips would help them, especially in mature weapon systems. There, the major failure of the program was that little actual technology insertion was achieved.

This lesson should be kept in mind when our present leadership thinks of developing future technology and then putting it "on the shelf." The authors recommend that the Pentagon find a way to reduce disincentives driving commercial firms away from defense business. Simultaneous engineering should be the incentive so future technologies will be more manufacturable and maintainable; accounting procedures and regulations changed so firms are not prohibited from integrating government and commercial businesses; and, military specifications and standards brought into agreement with commercial best practices if spin-off and spin-on are to be achieved.

This book should be on the desk of every serious student of the industrial base and global competitiveness.

Jack McGovern, Professor, Manufacturing Management Department, DSMC

TOOLS OF THE TRADE

A Workman's Bag

Michael L. Tompkins

A workman has a bag of tools. He begins his career with shiny new ones made of polished chrome and plastic. He digs through all of them to find the ones he needs for his first job. Then, he begins his career with the turn of a shiny new wrench or a new screwdriver. Over time, the tools he uses most often will accumulate at the top of the bag, and the others, depending upon the occurrence of their use, will become stratified toward the bottom. As they move down, they will become dull and a few will even rust from lack of use. Some tools will never be used, though the workman has made a significant cash investment in them, too.

As time passes, the tools he uses most will wear out and be replaced. A few special tools will be added to the bag, and the workman may even design and build some new tools for himself to make some of his work easier. Throughout his career, the workman will carry his bag of tools with him. All of the tools with which he began his career are still in it, though some are forgotten and never used.

Accumulating Useful Tools

Skills and knowledge that are acquired over time are useful tools. Some become forgotten because they are seldom or never used in our daily lives. The ones we use most will quickly become a part of our routines. Others, because they achieve the needed or desired results, will be added to the top of our bags. Without our set of tools we are incapable; with them, we can do great things.

People and organizations tend to push some of their tools, or skills, knowledge, capabilities, and even some of their employees toward the bottom of the tool bag where they are forgotten from lack of use. This is from being in a routine of using only tools and people that produce results and personal or organizational rewards. Occasionally, new tools suit only routine needs, and produce little real benefit. These tools, too, tend to be adopted and added to the top of the bag because they are used frequently.

How often have we pulled a book of regulations from the shelf and found in it things we suddenly remembered were there and were needed to accomplish our task?

How often have we gone through old files and found information that helped us solve a problem?

How often have we talked to a colleague and discovered he or she knew something that proved helpful? And, how often have we done something that was routine and found out later it was wrong; we hadn't bothered to read germane information or research the facts?

How Good Are They?

For skills and knowledge to be useful they must be kept current and accurate, and they must be used or time will dull their "shine." This requires constant awareness of changing events and persistent personal effort. We can drift easily into comfortable routines that require the same tools every day and little effort. Over time, many of the tools we carry eventually will become rusted and forgotten from lack of use. This is especially true in government service where we are not as driven by the forces of "the market," the press of competition, and the dynamics imposed by constant change. New tools are given to us daily in the form of information, personnel and organizational changes around us, and training. All of the old tools are still there, too, though they may have become dull and forgotten from lack of use.

Use Keeps Them New

As organizations and as individuals we are all workmen in our trade, and we will always carry our bags full of tools in the form of our accumulated knowledge, skills, and our organization's capabilities. If we are aware only of the tools at the top, the ones we use most often, we will miss the capabilities and the opportunities the remaining tools offer. We must keep an inventory of what we have so we know all that our many tools can help us to achieve. We must be aware constantly of opportunities to use the tools we have so none will ever be lost, wasted or forgotten.

Mr. Tompkins is Production Management Specialist, Contractor Logistics Support Division, Air Logistics Center, Tinker AFB, Oklahoma City, Okla.

FROM THE COMMANDANT

Greetings again. Since I last talked with you, I have had the opportunity to see a large portion of our DOD and see firsthand the fruits of our acquisition process. I recently participated in the NDU Capstone course. This congressionally-mandated course is required for all new general and flag officers. The purpose of the course is to expose these officers to all aspects of the DOD, our federal government and selected foreign governments, to include views from senior leaders, pressing issues and the workings of key processes. Several thoughts regarding our acquisition process occurred to me during this course, and I'd like to share a few of them with you.

The first thing that struck me was how much the DOD military has institutionalized joint operations. All of our military services are actively engaged in integrating their operations. Changes in training concepts give excellent examples. The Army National Training Center, Fort Irwin, Calif., and the Air Warrior at Nellis AFB, Nev., have integrated their efforts to provide realistic air-land battles. Both Red and Blue army commanders call upon air forces to support ground objectives using established, real-world, joint procedures. Thus, the Army and Air Force get a great opportunity to train the way they will fight — "joint." Other training examples find the Air Force Red Flag, the Navy Top Gun and Navy Falon participating in each other's exercises as well as updating and integrating their training ranges. The recent Ocean Venture exercise conducted in the Caribbean provided not only an example of U.S. joint operations but, also, coalition operations since other countries participated.

These are only a small fraction of the changes in how our forces conduct their operations. What does all this mean to us? First, we as "acquisition types" need to realize this has happened and our users and their requirements will and have changed in response. As we review requirements, we need to ask our user and ourselves "what are the joint implications. This is particularly important when we work the C4I systems. In fact, C4I can no longer be considered as a separate acquisition if we are to maintain the system management aspect of our acquisition; particularly, joint pursuing will be impossible without due thought to joint requirements. Integrating the Air Forces Red Flag, the Navy Falon and Top Gun training ranges requires significant attention to joint requirements. Integration of battle/campaign simulations from various military installations around the country require the same attention.

Special operations forces, also known as "special ops," are not exempted and may be a microcosm of what will be demanded of our acquisition process in the future. Special ops effectively combine air, land and sea forces to accomplish their mission. Typically, the special ops requirements are very demanding from both a joint prospective as well as an extremely compressed schedule or IOC prospective. To a large degree, many of us are excluded from the special ops acquisition process because we do not understand the special ops requirements. Even if we did, our process is not viewed as being responsive to the special ops needs; particularly, the short acquisition time lines often required. Increasing our efforts to fully meet the special ops requirements would go a long way in addressing the joint requirements as well as adding value to the special ops acquisition process.

These are a few thoughts on how I believe our acquisition process will be asked to change in the future. Other immediate changes are taking place and I will pass those on to you in future *Program Manager* articles. One of the most interesting will be the improved and shortened PMC to debut 95-1. More on that and other changes next time.

—Brig Gen (Sel.) Claude M. Bolton, Jr., USAF

1993 PM Articles

A Quick Checklist for Last Year

January-February

- Getting to the (Right) Bottom Line—Dr. Paul A. Ballou, Jr., and Bert A. Milliken, p. 2.
- Career Counseling During the Drawdown—Major Jody V. Rennie, USAF, p. 6.
- Advisory Panel Formed—Donald M. Freedman, p. 10.
- The American Golden Rule: Past and Present—John F. Leonard, p. 14.
- Game Theory in the P[illegible]rement of Major Weapon Systems—Lt Col [illegible] E. Heberling, USAF, and Major T. Scott [illegible]m, USAF, p. 20.
- Lean Production—Lt Col Leslie Anderson, USAF, p. 26.

March-April

- Counterpunching the U-Boats—Wilbur D. Jones, Jr., p. 2.
- Getting the DOD/Industry Partnership Back on the Right Track—Dr. Robert F. Burnes, p. 12.
- Welding—William T. Motley, p. 19.
- The Political Process in Systems Acquisition Design—Brenda Forman, Ph.D., p. 22.
- Updated DSMC Handbook—Calvin Brown, p. 27.
- The Carburetor and Electric Credo—Lt Col Scott Rounce, USAF, p. 28.
- New Ethics Standards Simplify the Rules—James D. Alstott, p. 32.

May-June

- The Metamorphosis of Program Management—Colonel W.E. Cole, USAF, p. 4.
- Manufacturing in the New IWSM Environment—Lt Col Les Anderson, USAF, p. 18.
- Smart Sourcing—William C. Hillsman, p. 20.
- How Can We Measure Leadership Performance?—JT Carr, p. 24.
- Evolving a Set of Program Management Principles—Dr. John J. Bennett, p. 30
- Existential Program Management—Owen Gadeken and Forrest Gale, p. 34.

July-August

- Dr. Deutch Restructures Defense Acquisition Organization, p. 2.
- The Work Breakdown Structure—Dr. Jerry Lake, p. 3.
- Spruce, Dope, and Fordism: The Flying Coffins—Wilbur D. Jones, Jr., p. 10.
- Acquisition Law Panel Reports to Congress—Colonel Kenneth Allard, USA, p. 26.
- Procurement Integrity—Chris Scott, p. 35.
- Empowering Your Team—Steve Gierhart, p. 38.
- Managing Technology—Gerald Moeller, p. 42.
- Changing Role of Government Laboratories—Dr. Joseph W. Lee, p. 48.
- Test and Evaluation Oversight—Lt Col Jeffrey R. Riemer, USAF, p. 52.

September-October

- DOD Acquisition Reform Underway at Pentagon—Catherine M. Clark, p. 2.
- DSMC/FAA Interagency Agreement—Tony Rymiszewski, p. 6.
- A New Program Manager's Guide to People—Deanna J. Bennett, p. 8.
- Restructuring the Acquisition Organization—Hermann O. Pfrengle, p. 12.
- DOD Contract Performance Management and TQM—Joseph R. Houser and Dr. Kenneth A. Potocki, p. 16.
- Reengineering Business Organizations—Dr. James E. Price, Dr. Sharlett Gillard and Dr. Mary-Blair Valentine, p. 22.
- Foreign Military Sales Cooperative Development—John L. Sweeney, p. 26.
- The Ever-Current Issues in OT&E—Dr. Ernest A. Seglie, p. 30.
- Lean Production—Major William B. Vance, USAF, p. 38.

November-December

- All-Steam, All-Steel: White Squadron to Great White Fleet—Wilbur D. Jones, Jr., p. 2.
- Cost-Plus-Percentage-of-Cost Contracts—Paul Stein and Dr. Eileen Donnelly, p. 18.
- A Generic Rationale for Long-Term Residential Programs—Dr. Ronald J. Stupak, p. 22.
- Industrial Development—Major J. Brian Turk, USAF, p. 24.
- Reengineering Cost Analysis—Mark E. Gindele, p. 26.
- Architecture II: The Prototype—Joseph R. Zaleski, p. 30.
- Assessing the Military Industrial Base—Ed Houston, p. 36.
- DSMC Research Fellows Handbook Concerns Modeling and Simulation—Lt Col Richard O. Roop, USAF, p. 44.